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OF THE

WISCONSIN ACADEMY

OF

SCIENCES, ARTS, AND LETTERS.

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THE ENGLISH COTTAGERS OF THE MIDDLE AGES.

BY PROF. W. F. ALLEN.

In the statute entitled *Extenta Manerii*, enacted in the fourth year of Edward I. (1276), three classes of tenants of the manor are enumerated: the *libere tenentes* or freeholders; the *custumarii* or customary tenants; and the *coterelli* or cottagers. In former papers I have inquired into the origin of the two first of these classes, and attempted to show that the customary tenants were representatives of the primitive village community, and that the freeholders were of feudal origin. In the present paper I propose to consider the third class, the cottagers.

The class who, in this document, are called *coterelli*, are known by several other names — *cotagii*, *cotmanni*, *cotarii*, *coterii*, *cotlandarii*. The several manors enumerated in the Gloucester Cartulary use these terms indifferently, while the Domesday of St. Paul's, in a passage corresponding to that in the *Extenta Manerii*, uses the word *cotagii* instead of *coterelli*. The Exchequer Domesday has *coterii* and *cotmanni*, as well as a new variation, *cosceti* or *coscez*, and the laws of Henry I. also mention *cotseti*. Lastly, the *Rectitudines singularum personarum*, of the period before the Norman Conquest, has *cotsetlan*, a form which is repeated in the *consetl'* of the Abingdon Cartulary, in the latter half of the twelfth century.

Here are ten forms of the same word, evidently having the same derivation, and apparently the same meaning. Nor is there any difference discernible in their tenures and services. They generally hold a messuage and curtilage, that is a cottage with a yard, or an acre or two of land, and render therefor some trifling services. Still they occasionally are found with estates of considerable size; as, an entire virgate,[1] twelve acres,[2] ten, nine and

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[1] Domesday of St. Paul's, p. 5. [2] Boldon Book, p. 566.

so on.[1] Neither are we entitled to assume an absolute identity in the several terms, inasmuch as *cotarii* and *cosceti* are occasionally found in the same manor.[2] To add to the perplexity, Domesday Book regularly uses a word of entirely different etymology, *bordarii*, for the class of cottagers, the terms *cotarii*, *cotmanni* and *cosceti* being only occasionally used, and then being often found on the same estate with *bordarii.*

The differences here indicated were no doubt slight and unessential: and at any rate it would be a hopeless task to attempt at the present day to trace them in detail. Let us return to the threefold classification made by the *Extenta Manerii;* this classification evidently indicates broad and intelligible distinctions. We will inquire first into the position of the cottagers of the thirteenth century, and then proceed to trace the origin of the class. We are here at the start upon firm standing ground. The cottagers of the thirteenth century are sufficiently well understood: in order, however, to make their condition intelligible, a brief review of the previous history of the peasantry will be necessary.

The peasantry of the Germanic nations were, in the earliest times, divided into small communities, each occupying a definite tract of land, called *mark*, which they owned and cultivated in common. When they reached a more advanced stage of progress, which required the ownership of land in severalty, each member of the community received an equal portion of land, consisting of house-lot and arable land, with rights of user in the meadows, pasture and forest, which he held as his own, subject, however, to the methods of cultivation followed by the community. This share was called in England, *hide*, on the continent, *mansus.* At first the proprietor of the hide held it as it were in trust for his family; he could not alienate it, but must transmit it to his heirs. Soon, however,—at a very early time in England,—he acquired the right of alienation; and, as a matter of course, the primitive equality of ownership was speedily succeeded by great inequality. A few became rich, others were forced to dispose of a part, or

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[1] Exchequer Domesday, i. f. 128.

[2] e. g., Carletone in Wiltshire. Id. p. 67.

even the whole, of their land. We have, therefore, rich peasants, poor peasants, and landless peasants.[1]

The name given to the village mark in Latin — the language almost universally used for public documents in the middle ages — was *villa*, and its inhabitants were *villani*. Now in the changes in landed property, so long as a man kept his hold upon his share (hide), or even upon any aliquot portion of it, he was by right a *villanus*, a "townsman," and entitled to all the political and economical privileges which belonged to the community. Thus, the manor of Sandun[2] gives first of this class those who held half a virgate (i. e., one eighth of a hide, the regular share having been reduced to this amount by successive subdivision), then the *operarii* of ten acres, and then those of five. These three classes were the *villani* proper, or, as they were now called, the *custumarii*, or customary tenants. They were the higher order of serfs, bound to labor by an hereditary obligation from which they could not escape; but having an interest in the soil, also hereditary, and of which they could not be deprived. Above them were the freeholders, *libere tenentes*, also having an interest in the soil, and held to labor; but an interest and an obligation resting upon definite and personal contract. But there was a class below the customary tenants; serfs, like them, held to labor by an obligation which they did not themselves enter into, and from which they could not escape, but having no interest in the soil to compensate for it. They might hold land, even in considerable amount; but it was purely at the will of the lord. These were the cottagers. If the customary tenants may be called *villeins regardant* (prædial serfs), the cottagers may be called *villeins in gross* (personal serfs), with a status hardly better than that of slaves proper. Both classes held their lands nominally "at will," but with the customary tenants the prescriptive rights of the tenant were effective against the bare legal right of the lord.

It will be noted that there were no slaves in England at this time (the close of the thirteenth century.) There had been at an

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[1] See, on this point, Thudichum, *Gau und Markverfassung*, p. 211.

[2] Domesday of St Paul, p. 13.

earlier time, but they had been gradually emancipated, and were, of course, one element of the class of cottagers. Another element was the poorer or more shiftless members of the village community; however low they might sink, so long as they retained, by prescriptive right, a share in the mark, they were *villani*, or customary tenants; if they lost this, and were dependent upon the lord for grants of land, they were cottagers, tenants at will.

Personal status and tenure of land are two points of view from which every class of persons in the middle ages must be regarded. In treating of the changes in landed property, I have partly anticipated the companion topic of personal status. While the hide was subdivided, and while many members of the community were losing their share altogether, a parallel process was going on, by which the entire body of free villagers, *villani*, were transformed into serfs. And side by side with this was a process familiar to all students of social history — the converse process, by which the slaves were elevated in position and became personally free, while still held to obligatory labor. The common freemen, by a process of degradation, and the slaves, by a process of elevation, met on the common ground of serfdom, and were distinguished from one another, not by any difference in personal status, but by their relation to the land. The common freemen, the *villani*, were now villeins regardant; the landless freemen and the slaves were villeins in gross, or serfs proper. For it should be noted that the distinction made by modern law writers between villeins regardant and villeins in gross is not recognized by the law writers of the time, and must be considered as not at all a difference in personal rights, but in right to the land. *Quicumque servus est*, says Fleta,[1] *ita est servus sicut alius, nec plus nec minus.* The higher class were attached to the soil simply because they had a prescriptive and inalienable right to the soil; the lower class could be transferred from hand to hand or estate to estate like slaves, simply because their obligation to labor was not joined with a permanent right to a definite estate of land.

Therefore, we have a clue to start with — the two fold origin of

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[1] Book I. 3. 3.

the cottagers. We must look to the slaves as well as to the landless freemen, for their source.

For assistance in this enquiry we must have recourse chiefly to two documents of the 11th Cent.; the *Rectitudines Singularum personarum*, which gives the obligations of three classes of free peasants shortly before the Norman Conquest; and the great or Exchequer Domesday Book, which gives the numbers, on every estate, of two principal classes, only in a few cases stating the extent of their tenure and their obligations. Both documents mention also slaves; but it must be undestood that the "slave" of this period was rather a serf than a chattel slave. It will be noted that the passage from Fleta, just cited, uses the word *servus* at a time (about A. D. 1300) when chattel slavery had been long abolished.

Our three principal documents therefore give us the following classification: the *Rectitudines singularum personarum*, three classes, *Geneat*, *Cotsetel*, and *Gebur*; Domesday Book, two classes, *Villani* and *Bordarii:* the *Extenta Manerii*, three classes again, *Libere tenentes*, *Custumarii* and *Coterelli*. Our problem is to reconcile these differences.

In the first place, it should be remarked that the *Libere tenentse* or freeholders, having come into existence since the time of Domesday Book, do not correspond to any one of the earlier classes, and may therefore be left out of account. In the next place, it is perfectly well established that the *Geneat* of the *Rectitudines*, the *Villani* of Domesday Book, and the *Custumarii* of the *Extenta Manerii*, are the same class. We have therefore only to determine the relation of the *Coterelli* to the others of these earlier classes; and especially to explain how it is that Domesday Book has only one principal class, the *Bordarii*, where a few years earlier there were two, the *Cotsetel* and the *Geburs.*

Here I must call to mind the fact to which I directed attention a short time ago, that the class of *Coterelli* had its origin in two sources — the slaves and the landless freemen. The slaves, therefore, of the eleventh century were certainly one source of the cottagers of the thirteenth century; and so, in all probability, were a part at least of the classes intermediate between the slaves and the *Villani* — that is, the *Bordarii* of Domesday Book and the

Cotsetel and *Geburs* of the *Rectitudines.* Let us proceed to examine these three classes.

The essential features of the *Kotsetlan-riht*, according to the *Rectitudines*, are the following: the *Cotsetel* is explicitly spoken of as a freeman, but as not paying a land tax, like the *Geneat* or *Villanus;* his holding is generally five acres, and his regular obligations are one day's labor a week. His free status associates him with the *Villanus*, but his obligations — labor instead of money or produce — appear to show that his tenure is not one of prescription, like that of the full member of the community, but is at the lord's will. These features all point to this class as that of which we are in search — freemen who have lost their hold upon the land, and who have received from their lords small and precarious grants. The obligation to labor one day in the week seems to have been a very common one in England. In analyzing some years ago the tenants of some English manors at the period of the *Extenta Manerii*, I found a class intermediate between the *Custumarii* and the *Coterelli*, which it was difficult to attach positively to either of these classes. These are the *Lundinarii* or "Mondaysmen," who had holdings ranging from two to six acres, and labored one day a week throughout the year. I pointed out this feature which they had in common with the *Cotsetel*, but did not attempt at the time to pursue the subject further.

The *Geburs* are described, in the same document, in terms, which show that they were not a free class, and were in a rather harsh condition of serfdom. Their ordinary obligation was two days a week (besides numerous occasional services), their holdings averaged larger than those of the *cotsetel*, and they received stock and seed; but at their death everything they had was the property of the lord. This last is the clearest mark of serfdom, and is called *mainmorte.*

We pass now to Domesday Book. The names of both the classes above described are found in Domesday Book, but in very small number; there are enumerated in all England 1749 *cosceti* (all in the west of England), 5,054 *cotarii*, mostly in the south, a few *cotmanni* and 64 *Geburs*, also in the south. Of course it is impossible that this handful should represent the cottagers as a class. The class of cottagers are the *bordarii*, 82,119 in number, distributed in due proportion in every part of England, and constantly associated with the *villani*, 108,407 in number. Here we have evidently the customary tenants and the cottagers. Unfortunately Domesday Book rarely gives any information as to the obligations of the several classes. We have however, a few items of information. In the first place the *bordarii* are regularly associated with the *villani*,[1] from which it appears that they occupied the village and not the lord's demesne. In one case their labor is put at one day in the week.[2] And although as a rule, the holdings are not given, yet in several manors of the county of Middlesex they are given in detail; and here we find the *bordarii* holding five and six acres apiece; also holdings in common — 6 *bordarii* of 30 acres, 16 of 2 hides (acres not given), 36 of 3 hides, 4 of 40 acres, and 8 of 1 virgate (or one-fourth of a hide). From these data it follows with certainty that the *bordarii* were an outgrowth of the village community; that they were originally villagers like the *villani*. They would appear also to have held their lands by prescription and not at will; but this is not a positive inference, and on other accounts seems hardly probable.

With regard to the *cotarii*, we learn just about as much as with regard to the *bordarii*. We find these too associated with the *villani*,[3] and find them holding four and five acres apiece, or mere gardens for a shilling each,[4] or, in common, 3 with 9 acres, 2 with 4 acres, 22 with half a hide, and 46 with a whole hide. These facts prove that the *cotarii* likewise were an outgrowth of the village community, and belonged properly to the class of *villani*. But the *cotarii* and *cosceti* are so few in number and so scattered, that we can infer very little in regard to them.

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[1] Vol. I, f 4. a; Leminges in Kent; centum et unus villanus cum xvi bordariis habentes lv carucas. f. 284 c; Colingeham in Nottinghamshire; vii villani et xx bordarii habentes xiv carucas. f. 350. Tatenai in Lincolnshire; v villani et ii bordarii arantes v bobus.

[2] Vol. I, f. 186. Ewies in Herefordshire. xii bordarii operantes uno die ebdomeda.

[3] Vol. I, f. 9. a. Wicheham in Kent. xxxvi villani cum xxxii cotariis habent ix carucas.

[4] Vol. I, f. 128. Westminster in Middlesex.

The name *bordarius*, used in this document and in a few other occasional cases, may assist us to a conclusion. It is a French term, used by the French officials of William the Conqueror instead of the native English term. In France, the *bordarius* was the tenant of a *bordaria*, a smaller estate attached to a *mansus* or hide, upon the outskirts of which it was situated[1]; the *bordarius*, therefore, although not a full member of the community, was an outgrowth of the community and belonged, by origin, to the class of *villani*. He was a cottager, but a cottager of free origin.

The French *bordarius*, therefore, the occupant of a cottage upon the estate of another peasant, belonged by his origin to the class of *villani*, but did not hold his land by prescriptive right, like the *villani* proper, but by special grant, like the serfs. He was a cottager, but a cottager of free, not servile, origin. It does not follow, of course, that the compilers of Domesday Book used the term strictly in this sense. In all probability it meant to them simply *cottager*, and they applied it without discrimination to all those English peasants whom this term could properly describe. It is not surprising that they classed together, under this name, the *cotsetel* or free cottagers, and the *geburs* or serfs, seeing that these classes agreed in occupying cottages with a few acres attached. It must be remembered that Domesday Book does not, as a rule, record *tenures* but classes of men. It was no object to distinguish between the different classes of cottagers, whether as to tenure or as to status. And if in a few instances we have *cotarii* or *cosceti* by the side of *bordarii*, all we are entitled to infer is that the officials who drew up the report of this particular manor, noted distinctions which other officials passed over as insignificant; that the distinctions existed generally, but were not generally put on record. It was not even necessary that the *bordarius* should hold any land at all. Domesday Book mentions one *bordarius* who, on account of poverty, had nothing,[2] and ten who had no land of their own.

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[1] Lamprecht; Beiträge zur Geschichte des französischen Wirthschaftslebens, p. 38.

[2] Vol. I. f. 177 b., Hatete in Worcestershire. Vol. II, f. 290, Gepeswiz in Suffolk.

We are therefore entitled to conclude that under the French name *bordarius*, Domesday Book includes the two Anglo-Saxon classes of *cotsetel* and *geburs*, two classes which were both, probably, of free origin, but one of which had sunk into genuine serfdom, while the other might still be described as free peasantry. Two hundred years later, the class of cottagers included also the now emancipated slaves, all being equally serfs in status, and equally lacking any interest in the land, beyond that of a tenure at will.

But the cottagers of free and of servile origin, although agreeing in status and in tenure, were nevertheless not wholly identical. They appear to have differed in the locality of their residence and tenure. It has been already said that the cottagers of free origin in the eleventh century, so far as can be traced, being sprung from the class of villagers, had their residence in the village[1] among the tenants of higher class. This is certainly the case with the French *bordarii*, and it may be inferred to have been the case in England. But the slaves, being the personal property of their lord, had their residence, not in the village, on the tenement lands or *utland* of the manor, but on the lord's personal estate, the demesne or *inland;* just as, on our southern plantations, the negro quarters were in the neighborhood of the "big house." When the slaves were emancipated, it was natural that they should continue to live upon the demesne, occupying cottages and petty holdings just as the older class of cottagers did upon the tenement lands.[2] Or if new lands were cleared upon the waste, they might receive patches of this. At any rate they would not be in the village with the customary tenants and their companions.

This probability is converted into a certainty by a few isolated facts which we meet with in the period between Domesday Book and the *Extenta Manerii.* The rent-rolls of the end of the 13th century, the period of the *Extenta Manerii*, class all the cottagers

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[1] See, for the residence of cottagers in the villages of Germany, von Maurer. *Geschichte der Fronhöfe*, Vol. III, p. 198.

[2] Von Maurer, id. p. 311, speaks of *coloni* upon the *Hofländereien* (or demesnes.)

together. The status and the tenures had now reached their fully developed form. But in the earlier rent-rolls we find these classes clearly distinguished. Thus the Abingdon Cartulary,[1] after enumerating the free-holders and customary tenants of the manor, adds (manor of Boxole): *in eodem hamel sunt* xv *cotsetl' ad opus*, etc.; and then goes on: *Hi extracti sunt a dominio*, giving the names of twenty-six petty tenants. A few years later (1222) is the Domesday of St. Paul's, edited with learning and judgment by Archdeacon Hale. This contains the rent-rolls of twenty-two manors; and in nearly every case the roll begins with *Isti tenent de dominico*, to which follows a list of petty holdings upon the demesne; then come the free-holders and other tenants. *Cotarii*, when there are any, are put after the free-holders and customary tenants, that is, upon the tenement lands. I cannot find any direct evidence to support the view, in itself shown to be probable, that these tenants in the demesne were the descendants of slaves. It is noticeable, however, that the handicraftsmen are generally found here;[2] and upon the continent it is an established fact that the handicraftsmen were of unfree origin; whether it was so as a rule in England or not, I cannot say.

The same document enables us to make a comparison between the tenants of the same manor at two different periods which, so far as it goes, confirms the view here taken. It must be observed that the period between Domesday Book (1086) and the Domesday of St. Paul's (1222) was full of convulsions, social as well as political. During this time the class of free-holders came into existence, and the class of slaves went out of existence. It is difficult, therefore, to trace any clear connection between the classes of the peasantry in the two documents. The following will serve as examples. The manor of Sandun in Middlesex had, according to Domesday Book,[3] 24 *villari*, 12 *bordarii*, 16 *cotanii*, and

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[1] Vol. II, p. 301.

[2] Thus, in the manor of Beauchamp, p. 33, I find *textor* (tailor), *pelliparius* (tanner) *faber* (smith) *carpentarius* (carpenter) and *pictor* (painter). So in the manor of Boxole, given above, there were a tanner and a miller upon the demesne.

[3] Vol. i. f. 136.

11 *servi*. In 1222 there are 24 *operarii* (corresponding exactly to the 24 *villani*), only 8 *cotarii*, 23 *libere tenentes*, and 24 tenants of the demesne, a considerable number of whom are also reckoned in the other classes. This would appear to show that the freeholders originated in cottagers as well as in *villani*.

In the little manor of Norton, in Essex,[1] there were only two *bordarii*; in 1222 there were six tenants holding from five to ten acres apiece. Here it would appear that the *bordarii* were petty tenants with no special rank.

The conclusion which we seem entitled to draw, is that the *Cotsetel* of the *Rectitudines*, lumped together with other cottagers in Domesday book, were nevertheless a quite permanent class, reappearing in feudal times, under the name of *Lundinarii*, or "Monday's men," as a kind of aristocracy among the cottagers; that the *Geburs* were, like the *cotsetel*, of free origin, but lower in condition, and that they were the principal source of the cottagers upon the tenement lands; while the cottagers of the demesne and the cleared lands were in great part the descendants of the slaves of the eleventh century.

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[1] Vol. ii. f. 12.

THE PHILOSOPHY OF HISTORY.

BY PROF. A. O. WRIGHT.

Within the last century the study of history has taken a new departure. The materials of history have been sifted more carefully, and researches have been made in every direction for new material. The monuments of Egypt, of Assyria, and of Babylonia have been made to give up the dead languages buried in them, and to tell the tale of their forgotten dynasties. The ancient language and civilization of Hindoostan reaches across the eastern continent to claim kinship with the sons of Japhet in the West. Historical and antiquarian societies have sprung up all over Europe and America to gather every document and every monument that can furnish material or illustration for history.

Historians are beginning to pay more attention too, to the grand forces that move society. History is ceasing to be the annals of monarchs and the story of battles and is coming to be more and more the record of the collective life of a nation or of the whole human race. The scope of history is thus greatly widened.

And, thirdly, there is coming into existence a philosophy of history which attempts to explain the causes of the greater movements of mankind. Thus in a history of any nation or epoch we may reasonably ask for three things, accuracy of detail, breadth of view, and a presentation of causes and effects, or the philosophic relation of facts. It is with the last that this paper will attempt to deal.

There are three great conditions of history. Each of these is claimed by one school of historians to be the chief or only cause of human history. And according as we lay stress on one or another of these great conditions will our whole interpretation of history vary from materialism to idealism.

The first great condition of history is found in the physical characteristics of the earth. Of these the most important is climate; but all the physical conditions that affect commerce agriculture or manufactures should be grouped together here. The chief of these are climate, fertility of soil, access to the sea or navigable waters, level or mountainous surface, and workable veins of metallic ores. There is a school of historians who insist that these physical conditions explain all or nearly all the great movements of history. And one historian of this school has gone so far as to make climate the sole cause of our civil war, and to prophesy therefore that as north and south have different climates they must always be hostile, and to predict a succession of wars between them.

The physical conditions of the earth will doubtless explain much of its history. The first civilizations of the earth sprang up in the semi tropical alluvial valleys of the Nile and the Euphrates, where the conditions of life are so easy that a dense population can be supported. The sea coasts have been favorable to enterprise, and the mountains to freedom. The tropic and the frigid zones have nourished indolent savages; the temperate zones have been the abode of civilized man. Iron or bronze have been the necessities, and gold and silver the luxuries, that mark the beginning of civilization. Had England remained connected with the continent in historic as in geologic ages, Henry VIII and Charles I could have become despots, and Napoleon could have conquered her. Climate and soil made cotton king, and slavery profitable enough to be worth fighting for.

But the physical conditions of the earth will not explain everything. The valleys of the Euphrates and the Tigris were once the seat of empire, why are they so no longer? The same sun shines on the same soil, watered by the same rivers; the physical conditions are the same as when Babylon, or Nineveh or Bagdad stood in splendor; but other causes are weighing on that fair land. The creed of Mohammed and the greed of the Turk are stronger to destroy than climate and soil are to build up. England and Japan are strangely alike in their physical conditions, but while England has lived a thousand years of healthful progress, Japan lay in the sleep of feudalism, till awakened by American cannon. Other causes must be sought for the growth and decay of nations besides their geography.

The second great condition of history is found in the division of mankind into races, with their various characteristics. Here again, a school of historians is found to claim the characteristics of race as the main-spring of history. The laws of heredity and of the survival of the fittest in the struggle for life can be applied to the history of mankind as well as to the history of birds and beasts. But in the one case as in the other there is danger in trying to make these laws explain everything. The origin of our free institutions to-day can be traced in the stubborn hardihood and love of personal freedom of the German stock from which we have sprung. The same steady bravery of the Teutonic stock which won the day at Gettysburg and at Saratoga, changed the history of Europe also at Waterloo, at the siege of Leyden, at Morgarten and at Lutzen. The same love of local freedom, which created the United States of America, created also the kindred Federation of Switzerland and the United States of the Netherlands. But why have a part of the same race in Germany for a thousand years submitted to petty local despotisms, from which they have but just emerged? Why did the Arabs sleep in their peninsula till Mohammed came; and what has since become of the old Norse love of daring adventure? What is the secret of the marvellous change now going on in Japan? These are questions which history indeed can answer, but not a history based on race alone. The law of heredity can best explain the temperaments, features and dispositions of mankind. Leading traits of character will be preserved by nations through every vicissitude of fortune and every change of faith or clime. The Gaul of Cæsar is the Frenchman of to day in disposition, but not in institutions, language or religion. His leading traits have survived the influence of imperial and of papal Rome and of the German conquest. The Turk on the throne is still the Tartar of the steppes in spite of the Koran on the one hand, and of Europe on the other. Three thousand years have not sufficed to change the physical or the moral traits of the Greek, the Hindoo or the Negro. The law of race has its limits; but within these it is powerful.

The third great condition or cause of history is found in ideas. Man is distinguished from all other forms of life on this globe by his ability to grasp and to carry out an idea. The ideas which have ruled man may be grouped in four classes.

The most important ideas and the ones which have had most effect on history, belong to the first class, that of religious ideas. The history of modern Europe would not have been written at all had it not been for christianity, which recreated civilization. The great Protestant movement of the sixteenth century has given birth to Anglo Saxon freedom on both sides the Atlantic, and has built up a new German Empire on the ruins of the old. And the events of the past year are opening our eyes to the evil influence of the faith of Islam upon the destinies of the Orient.

The second class of ideas are the ideas of government. Until of late the history of the world was the history of its governments. Monarchy, aristocracy and democracy have all had their champions and their martyrs. The divine right of kings, the divine right of nobles and the divine right of majorities to rule, have each, at times, controlled the destiny of nations, and have been only less powerful than religious ideas in making history.

The third class of ideas are those concerning the family; whether it shall be composed of one man and one woman, with their children, or of one man and several women and their children, or of one woman with several men and their children; whether the union shall be for life, or at the pleasure of one or of both parties to the marriage contract; what shall be the position of the wife in the household, as a slave or an equal; what shall be the rule of inheritance for the children; what shall be the education of the sons, to the father's business or to whatever business they are fitted for; and the conceived analogies to the family found in the clan or in the nation. The history of China or of Turkey cannot be written without understanding the Chinese or the Turkish idea of the family. No one can rightly understand the complete social and political change in France since the revolution without studying the effect of the Napoleonic law of inheritance.

The fourth class are social causes, such as the tenure of land, the condition of the laboring classes, the state of general education and of the higher education and the opportunities for rising in life. No history of the Roman republic can explain its speedy decay without telling of the grasping land monopoly of the senatorial ring, and the consequent change of the Italian peasantry from free farmers to slaves. No history of the new Germany of Stein and Bismark could fail to tell of Prussian schools. And the whole history of our own country for the last half century turns upon the conflict of two systems of labor and two theories of education.

There are thus three great sets of causes which govern history: geographical causes, ethnological causes, and ideal causes. In an individual man we should call these outward circumstances, hereditary character and purposes of life. If we know these three things about a man, we know what that man is; and so with a nation, if we know the outward circumstances in which it is placed, if we know what sort of hereditary character it has, and if we know its leading ideas we know its history. Most historians err either by neglecting these underlying causes of history entirely, or by attaching far too great importance to some one of them at the expense of the others. In all ages of the world each of these causes has had some effect upon history. In the earlier ages and in all times among uncivilized tribes, geographical causes have had much greater power than among civilized nations to-day. Undoubtedly the differences of climate and locality worked far more rapidly in the first ages of the world, when men first divided the earth between them, than they do now. The whole history of barbarism is a history of adjustment to conditions of nature and the whole history of civilization is a history of triumph over nature. Obstacles which were insuperable even a century ago, are now easily overcome. To the barbarians of the Homeric song, a petty expedition against a small Asiatic city involved more difficulties and consumed as much time as it required of the later Greeks to conquer the whole Orient.

And as civilization is overcoming geographical difficulties by intellectual power, so also it is overcoming hereditary difficulties by moral power. The progress of civilization has been two-fold, in a material progress of subduing nature, and in a moral progress of subduing man. The history of government and of religion is the history of a constant triumph of ideal forces over inherited barbarism, and the gradual growth of a hereditary civilization.

Thus if we are to study the laws of history rightly, we shall allow a greater relative power to geographical and to ethnological causes in the earlier ages than in the later, and among barbarian than among civilized men. For instance, the time was when civilization was limited to navigable waters, because commerce was thus limited. And the teaching of Ritter that the proportionate extent of coast line on the several continents determines the amount of their civilization is true as far as it goes. But now commerce no longer depends on coast lines, but boldly explores the interior of great continents with its arms of iron, and civilization at once finds a home in Wisconsin as congenial as in the British Isles. The power of thought has conquered the resistance of nature, and ideas have reconstructed geography. Again, in the early ages of the world the first great nations were found in a subtropical climate under the isothermal of 70°. As men gained in skill in resisting the influences of cold on themselves and their works, the yet greater nations of classical antiquity grew up under the isothermal of 60°. And now the mental, and therefore the material power of the world, is found at about the isothermal of 50°.

Or take the rude barbarians over whom Alfred ruled, or the pagan savages, their ancestors of a few generations before, and contrast them with the Englishmen and Americans of to-day, and see what the combined forces of Christian faith, constitutional government, and scholarly learning have wrought, and see how the whole course of our history has been changed and ennobled by these ideas.

The ideal force in man is a greatly varying force and is capable of almost infinite growth, while the forces of climate and of race are nearly constant forces. While these are relatively more important factors of history at first, the force of ideas is a growing force which comes to be in modern history by far the most important. The student of history will err if he regards these forces as having a constant ratio to one another, and neglects to note the growing power of ideas.

It would be a fascinating subject of inquiry to ask what are the relations to one another of the ideas that have ruled the world, and the relative importance of each; but the limits of this essay forbid me to enter on that subject.

The three great conditions or causes of history, which we have thus far considered, are constant causes always at work. The influence of any one of them may be more or less in different ages or countries, but it is always something. There are other causes in history, which are occasional and temporary in their character, but which sometimes have great weight, and turn the course of history to a certain extent. But because they are occasional and transitory their effects are far less than these constant forces of which we have spoken.

There is, first, the influence of nations on one another. Mankind in past ages have been uniformly so selfish and narrow and cruel, as to think that one nation can only be happy and prosperous at the expense of other nations. The arts of war have had the honor and the service which rightfully belongs to the arts of peace. The history of the relations of nations has been a record of war, of conquest and of oppression. And, therefore, the decisive battles of the world are of interest to the student of history. Sometimes their results were a foregone conclusion, as when the training of Prussia in school and camp was matched with the ignorance of Austria on the field of Sadowa, or when Philip planned and Alexander carried out the first united effort of Greeks to conquer the effete Persian despotism. Sometimes they are decided by that class of providences which men call chance, as when the fire at Moscow broke the power of Napoleon, or the storm shattered the pride of the Armada. And not only the decisive contests, but the indecisive ones also have had great and varied effects upon the course of history. Of the Thirty Years' War, it is not enough to say that it resulted in a drawn battle between Protestantism and Catholicism; history must note also that it put back the progress of Germany two centuries, and made her for that time a mere "geographical expression."

The Crusades directly accomplished nothing; but indirectly they made barbarian Christendom acquainted with the civilization of Islam, and gave life to the germs of modern freedom in the free cities of Europe. And the wearisome and seemingly senseless wars of modern Europe to preserve "the balance of power," have helped to nourish that competition of nations in the arts of peace as well as war, which forms our best guarantee for a constant progress of civilization.

The influence of great men, too, should not be forgotten. That influence is often overrated. Of the heroes of history, many are sham heroes, followers, not leaders, who have made a great noise in the world, but have not perceptibly changed the course of history; and every great man must be in great degree the representative of his age, and know how to follow in order that he may lead. Yet, after every allowance has been made, there are certain great men, who have led their times and who have really made history. Such men as Cromwell, Richelieu, Pitt, Napoleon, Bismark, have made the history of modern Europe read in quite a different way, from that in which it would have read had they not helped to make it.

But above all these second causes, stands the first great cause of all history. If we believe that there is a God, we must believe that he has a plan in his government of the world. And if we believe this, history to us ceases to be the result of the conflict of blind physical forces, or the record of trials of strength between contending ideas. A regular purpose is seen to run through the providences of history. Some great idea is being unfolded in scene after scene of the great drama we are playing God's redemptive government of the world, is seen in the political sphere in the progress of liberty; in the social sphere in the progress of civilization; in the scientific sphere in the progress of knowledge, and in the religious sphere in the progress of christianity.

To understand history then we must recognize the reign of law there — physical laws, that set the limit of climate and soil and commerce, and thus limit the habits of man, and so modify his character — physiological laws that keep up race peculiarities and thus produce and limit habits and through habits character — psychological laws that raise man above the level of the brute by his teachability, and by his ability to conceive and to carry out far-reaching purposes, and finally the influence of a higher power upon the whole race. History is not a fortuitous sequence of events. It is subject to law, and is the working out of a plan in the Divine mind.

Says Bunsen, "To write the history of a nation is to recompose a canto in that great epic or dramatic poem, of which God is the poet, man the hero, and the historian the prophetical interpreter."

LIFE INSURANCE, SAVINGS BANKS, AND THE INDUSTRIAL SITUATION.

BY C. CAVERNO, LOMBARD, ILL.

Having occasion recently to borrow five hundred dollars, I applied for a loan to one of our successful life insurance companies, which has amassed assets amounting to many millions of dollars. I was informed that, whatever the security I might offer, the rules of the company forbade a loan for so small a sum.

Now that the regulation of the company was not wise, for its own convenience and protection, and for the interest of all those, myself included, for whom it was acting as trustee, I do not for a moment maintain. But this transaction represents a state of affairs to which I should like to call attention. We may find by investigation upon it some clue to the monetary stringency of the times — possibly some explanation of the malign aspect of the labor horizon.

In common with, say, forty thousand other men, I had been paying to this company small sums of money for a long series of years. Yet when I, or any one of my forty thousand fellow policy holders, wanted a loan for less than a thousand dollars, no matter what evidence we might give of financial soundness to the extent of the money desired, we must look elsewhere for it.

The funds of this company, as of all other companies, are largely made up from the contributions of the poorer class of young men — young men who are struggling for a competence, and who have taken out one or a few thousand dollars of life insurance, to secure creditors of whom they have borrowed small sums, or to tide a wife and children over the shoal of poverty in the event of death.

Now whatever the intent of life insurance may be, and however excellently it may serve certain purposes, yet here is a state of facts inviting reflection not only from the large army of policy holders in the United States, but from any one who will try to ravel intelligently the complications of our industrial condition. The men of humbler means, in putting their little savings into life insurance, have been aggregating vast sums with which large capitalists might operate, but from which they themselves could not get a cent for their lesser and, we shall maintain, equally safe enterprises.

The capitalists not having legitimate enterprises in which to put the larger sums which the insurance companies have placed at their control, have become speculators, have lost their ventures, and swamped the insurance companies loaded with bogus, insufficient or depreciated securities; and the insured and his money and insurance have been forever parted.

The working masses must reflect that the plethoric millions, which they boast of as constituting the assets of their favorite company, are so much money collected from themselves and put beyond the possibility of their own manipulation. More than a billion of dollars within a generation have been gathered from all quarters of the country; from all pursuits and occupations; from farm and country village, and massed for use in the large cities.

If this enormous aggregate were distributed to, or could be handled by, the people from whom it came, financial relief would at once be widely felt. The wheels of the humbler enterprises would be speedily oiled. When it becomes possible for *them* to secure accommodations, we shall start anew in industrial prosperity, and out of the sum of small movements we shall reach the possibility of great ones without peril.

It is in industry as in nature — you cannot have rivers without rills.

The facts are the same with reference to savings banks. They may serve the poorer classes well in some respects, but in others, and they are important ones too, they are an injury. They may help each individual to save his own, but they hinder each individual from being helped with the little surpluses of his neighbor. It is easy enough to deposit five dollars in a savings bank, but no poor man can get an accommodation of five dollars *from* a savings bank.

The man who loans the bank a small sum is welcomed. The man who wants to hire a small sum is recommended to the pawnbroker.

The aggregate sum in a savings bank is just so much money removed from the possibility of use among the poor and handed over to the rich to help them widen the distance already separating the poor and the rich. It is so much contribution to speculation under whose influence the value of wages is uniformly depressed as against the commodities the laborer needs to buy.

It is easy enough to see the road over which the savings banks have gone to the wide-spread ruin which is their recent history.

Many littles have made much; and the bank officers have found themselves in position to enter into operations to which wild times and greedy ambition invite.

Before any war of labor against capital, there has been a war of capital against capital — capital bidding against itself for the supposed profits of great enterprises.

If the best of these great enterprises could not be secured the next best must be and so on. The best has proved to be none too good, and the rest it is useless to try to characterize.

The poor in putting their surpluses into savings banks, have simply been standing idly by while capital has been employing their earnings in this interesting game of outwitting itself and them.

A savings bank for the poor is a great "How not to do it."

Men of small means need accommodations as well as those engaged in larger enterprises.

If an institution is for the benefit of the poorer classes, they ought to have a chance to get something out of it as well as to put something into it. This want a savings bank, if managed with ever so good intent, cannot in practice meet.

A radical fault in the savings bank system is that it is an attempt to relieve the poor from the necessity of taking care of their own funds — from the exercise of their own brains upon their own finances. The system promises to take care of the poor when they should be taught to take care of themselves. It prevents the poor from using what the naturalist would call the providential instinct.

The good savings banks accomplish is very much over estimated.

The statistics of amounts deposited are often taken as an exhibit of savings which would not otherwise be made.

The probability is that almost all that ever appears on the books of a savings bank would have existed as savings, only it would be loaned out in such ways that no statistician could reach it.

A thing that will astonish you, as you become acquainted with the depositors in a broken savings bank, is not the number of imbeciles that have been ruined, but the number of intelligent, capable, saving people that have been duped. Some of us can remember a generation of factory-girls who made close savings when no savings banks were within their reach.

The first spare money that came into the New Hampshire town in which I was raised, was the savings of our factory-girls. Almost every home took on a new appearance from the surpluses sent back by the girls at work in the factory. When fathers and mothers got in a pinch for money to keep a boy or girl at school, the first resort was to the savings of the factory-girls.

These young women were their own bankers. They did not ask any favors of savings banks. They found out to whom it was safe to loan and to whom it was not. They knew whether a man who sought to borrow their earnings had a mortgage on his farm or a chattel mortgage on his stock, and, if so, for how much and to whom. Some of these women remaining single and managing their own funds came to possess the large fortunes of their locality.

Now what a savings bank would have done for these factory girls would simply have been to make them babes in finance instead of self-sufficing bankers.

It would have led them to surrender to others an intellectual exercise in the highest degree profitable to themselves. Their earnings would have gone into a vast aggregate to be swallowed up by a kite-flying banker in the "down east" speculation which did ruin so many venturesome capitalists; and the clap boards and shingles would have rattled in the wind on the old houses which were spruced up, by their thrift, with white paint and green blinds.

If savings banks teach people to save (which is very doubtful), they still are an evil in that they paralyze the very faculty we most need to cultivate, and that is *the ability to manage savings.*

When representatives from half the families of a great city abandon the use of their own intellect by delegating to others (and these others, all told, numbering no more than a score) problems they themselves ought to solve, they ought not to be greatly surprised if the end of the transaction is catastrophe.

There are *moral* evils which demand consideration. The moral element plays an important part in finance. And by moral or morals in this discussion I refer to general intent, purpose, quality of life.

We substantially tell the poor by the savings bank system that they need take no care, on the score of morals, relative to their finances. The bank stands as a moral insurance company and takes the risk in that department. We say the difficulty of the times is want of confidence. But that want of confidence arises fully as much from fear of the moral meaning of men as from distrust of their intellectual ability or executive energy.

Whom to trust is the great question, and the ictus of it falls on the moral realm. But morality is strictly an individual matter. You cannot create a moral corporation.

Yet respectably intelligent people, by tens of thousands, have acted as though they supposed this had been done. They have gone like birds to the snare of the fowler to put their earnings in a savings bank, unsuspecting and without inquisition as to the morals of the men who were to handle their funds. A bank was a bank, and a bank was safe — a savings bank was safety itself come down to dwell among men, incarnated and apotheosized.

When you come to consider the question of safety it will be found that you cannot solve that matter until you have resolved moral elements. There the basis of safety will be found to rest in the good sense and honesty of the individual man — a man who can explain himself and his whole financial situation to the lender of money.

If banks are safe, it is because they are officered by such men. It is better to put on each individual the burden of finding out this honest man, in order to deal with him, than it is to delegate the search.

There are no safer sums than the majority of small loans, such as are made from man to man in the processes of small enterprises.

The moral element comes to the front in such cases. There is an element of personal faith in them worth more than any mere pride of financial honor that rules on 'change — more secure, *pro tanto* than the property values of the greater capitalists.

When men have been trained to find an honest and capable individual, they may be expected to be able to find corporations of similar character, if there is advantage in dealing with corporations. But to create corporations with an implied understanding that by them the poor are to be relieved from the exercise of moral providence, is an ethical blunder on its face, and we might have expected from it just what the history of savings banks in this country shows, failure distinguished, conspicuous.

But there is a moral fault lying behind the one discussed. Now that we have had so many disasters with savings banks, every body has fallen to work to devise some double-sure, iron-clad, adamant-bolted system of safety for the poorer classes.

We might pause on our way to ask who the poor are for whom we are to make such certain provision.

Where is the dividing line between the poor and the rich? Perhaps it is where the insurance companies draw it so that a man who cannot swell his wants to upwards of a thousand dollars, shall be regarded "*hors de combat financier.*"

We in Illinois have passed a statute that no savings bank shall receive on deposit more than four thousand dollars from one individual.

Society then to compensate a man for his inability to borrow, will step in and insure the safety of his loans to these amounts.

Why is it not the business of society to help a poor man borrow as well as to help him to lend?

But the moral question comes up: is the selfishness of the poor to be insured?

We are pretty careful to teach the rich that they are to regard themselves as stewards, and sometimes to take a little risk to help struggling worth upon its feet.

How far down the scale shall we come in pressing this duty? If a man has five thousand dollars to loan shall he have the moral responsibility of helpfulness loaded on him, while he who has five dollars only to lend shall think only of his own safety?

The truth is, the poor can help the poor as well as the rich, or the rich the poor, and they ought so to help one another.

The men of humble means ought not to be relieved from the responsibility of helping their fellows in the struggle for existence as they have opportunity.

The poor are on the war path against capital. What have they done with their own little surpluses? The chances are that in the scramble for safety they have shut their hands and their hearts against some humble enterprise, which might have been saved from ruin, in order that their little sums might further inflate the balloon of some rascal who ostentatiously paraded himself as a great capitalist.

We are wondering when "easy times" are to come again. They ought not and probably will not recur till "judgment begins at the house of God;" till the poor begin to be willing to help the poor; till they cease to regard safety to themselves as the ultimate good; till they are inspired to help others as well as to protect themselves.

When the poor have canonized selfishness by looking only for the safety of their own means, is it any wonder that a selfishness of broader grasp has confiscated all they have put in its possession? The game has been, "keep what you have and catch what you can," and at that the dozen directors have beaten the forty thousand depositors.

Life insurance takes its place in the savings bank system, and in the same way in respect to it the people have gone crazy.

The legitimacy of life insurance, under certain exigencies, and within certain rational limits, I should not wish to deny. I should even want to assert it. But the claim has been made that life insurance was the best form in which men could lay up property;

and thousands and tens of thousands of our young men, abdicating their own financial skill, have been cramping themselves and rendering themselves useless to everybody and everything in their own day and vicinity by carrying large policies on their lives. The aggregated premiums have constituted vast sums for which the directors of the company could not or would not find safe investment, and so we have had the recent history of insurance, and the end is not yet.

There is absurdity on the face of the matter that the directors of an insurance company can make and keep fortunes for forty or fifty thousand families. Propitious circumstances in singular instances may accomplish prodigies in this direction. But if that style of fortune making can be long and widely carried on with success, then most men *were* made in vain; man is a botch, and it is idle to reason about him or his affairs.

Well, this system of delegating to others what intellectually and morally pertains to ourselves, having failed on the old plans, the air is full of new schems. The only one which we can notice is the one which puts the national government into the breach.

The secretary of the treasury proposes a subdivision of the interest-bearing national debt minutely enough to put it into the power of the poor to utilize it as a savings bank system. That, for its own purposes, the government did not long ago do this is a wonder. But for the poor it is simply a proposition to tie the times up tighter; to take another twist on the screw of constriction under which the poorer classes already groan.

The result will be to collect all the little rills and send them just where all the greater streams have gone, to swell the vast amounts locked up in U. S. bonds, insurance assets, securities and stocks of all sorts — amounts removed partially or entirely from participation in the living enterprises by which society is supported and out of which wages are paid. It may be best under our present circumstances to adopt the plan. But let us clearly understand that the policy is a make-shift any way. Suppose, as all honest men mean it shall, the government sets the high example of paying its debts, what will become of this system of savings banks? Must the government keep in debt in order to maintain it? Then again, the very last thing we want to do is to add to the force of the feeling among the poor that the government is to take care of them. Even a government system of savings banks, in the long run, will be no kindness to the poor.

We are drifting all too rapidly to the notion that the government is to take care of us all. Here is even a religious newspaper of some note, advocating the idea that since we have lost faith in men because of bankruptcies and failures, we must now put the nation where before private enterprise stood. The poor, this journal says, will trust the nation as employer and paymaster.

Has not all this been tried over and over again to the overthrow of the nation that tried it — its rich and poor together? Rome stood in the gap and found corn for its people till the Goth came and "destroyed them all;" and that just because he was up to the problem of providing for himself and the Romans were not. "Lost faith in men?" why we have not put faith in men; that is just the thing we have been trying to avoid. We have been seeking safety on a property basis only, and have made no account of faith in men; and the men whom we have entrusted with our funds have known it, and have exhibited the same heedlessness respecting moral considerations we ourselves have shown.

We have lost our wits as to where the problem of industrial reconstruction is to begin. We are looking for it to begin at the top instead of the bottom; looking for it to begin where we left off, instead of starting anew.

We *were* looking for wars in foreign lands to create a demand for our products. Thank God, the European war last past proved that resource a broken staff!

We are looking for an era of railroad making to spring up again. But that era will not come again, as a private enterprise, till we have earned, from bottom dollar to top, the money to put into such kind of expenditure.

We are looking for the government to start a great system of internal improvements; to build the North and South Pacific railroads; to embank the Mississippi river; to dig a ship canal around the lakes or through the heart of the country.

By engaging in such enterprises, in the present condition of things, the government would simply break its own back, and take the burden off the back of nobody.

That is not the road to easy times. We shall strike that road when every man, rich or poor, will look about him, and try to put in practice in his own neighborhood some very old and humble wisdom, "To do good and communicate forget not." Then, like Bunyan's pilgrims in the bogs of the enchanted ground, we may "make a shift to wag along."

To this line of argument the reply may be made: The division of labor and the combinations of capital resulting in our large system of industry, have made the system of small savings and their management by individuals, as well as the system of small industries, no longer practicable.

It is said that as the factory has superseded the distaff and loom of our grandmothers — the railroad, the postman, the ox cart and the horse waggon — the reaper, the cradle and the sickle — so the bank and the insurance company have put an end to the feasibility of individual manipulation of money. This will lead us to take a look over the manner of our industrial condition. It is true we have very largely superseded the individual by the corporation — the man by machinery.

But the question will recur, after all, how much we have made by the process.

Somehow in spite of our division of labor and combination of capital we are all at the stand still. There is a hitch in affairs evident enough notwithstanding all our power to mass men and money.

There is a limit to the profitableness of combination, and the question I raise is, whether we have not in a great many things, reached and gone far beyond that limit. The question I raise is, whether our way out of our present complications is not, not by crowding ahead along the lines of combination on which we have been operating, but by taking the back track and paying more attention to the individual and less to the corporation — encouraging enterprises of individual and local character rather than those which attempt to do the world's business in the gross.

If a colonel can manage a regiment so splendidly, what would he not do with a million of men? Very likely lead them like sheep to the slaughter.

If a drive wheel of so much weight and diameter would do so much work, what would a drive wheel of a thousand times its weight and diameter do? Fly to pieces.

We have been massing men in the industries till the power of our *generalship* is exhausted, and your industrial army is breaking up into Mollie Maguires and tramps.

We have made our drive wheels so large that they are flying to pieces of their own momentum.

When coal and iron mining can be carried on only a few months in a year, and then at a rate of wages that would not be very enticing to a gopher, it is evident that capital in that business has passed the limits of its own safe management.

The same thing is evident, too, when the spindles and shuttles of our factories stand idle half a year, and are only operated the rest of the time by women and children at rates of wages that can scarcely support life for the time being.

Under such circumstances the sceptre of ability profitably to manage large masses of men has passed from the hands of capital, and the sooner that fact is acknowledged and acted on the better it will be for it and for civilization.

So when every one of the savings banks of a great city goes by the board, it is useless to talk about the profitableness of gathering up small savings and massing them that they may figure in the combinations of capital. "Suum cuique" would certainly work more satisfactorily than that.

And when wrecking and scaling are the order of the day in insurance, it is about time to take notice that combination in that way has passed feasable limits.

It is a pretty tough thing after all to abolish the individual; and we are not so near it as we thought we were with our great process of combination. And all our financial and industrial distress will pay for itself, when once that fact is seen and befitting action taken.

There are possibilities in man beyond any possibilities in machinery.

Notwithstanding all the genius that has been expended on the sewing machine, hand sewing is still the most popular. The deft hand has still the advantage in the struggle for existence.

There are machines to sew and peg boots, but the men are few who will not willingly pay more to have the foot measured and a fit made by a journeyman as of old. And the journeyman who can meet this want has good prospect of daily bread — a better prospect than the man who tends a machine.

Notwithstanding the perfection to which the processes of the reaper have been brought you can find *successful* farmers who will testify that forty acres of grain are more cheaply secured with the cradle than with the reaper — consideration being had to the amount of money you must put in a reaper, its interest, and the cost of repair.

The reaper has the advantage on the larger tract. But that larger tract calls for broad generalship, and the tendency of our development must be toward its subdivision.

The Hon. Hugh McCulloch called attention the other day to the Gwynn farm in California. It has thirty-six thousand acres in wheat, which is cultivated and secured, we may say, entirely by machinery.

But the ability to manage thirty six thousand acres of wheat with whatever help from machinery, will be as rare as the success of Choate and Webster at the bar, or of Beecher in the pulpit.

Agricultural machinery has altered man's relations to the markets, not essentially to nature. It has made it possible for skillful generals to make large fortunes from farming. But since "Adam delved and Eve y-span" it has been possible for a man with the rudest implements to make a living from a few acres of ground, and, will be in spite of all machinery, till men "shall hunger no more."

This is society's answer to the tramp.

This fact casts light on the inevitable redistribution of population between city and country — on the rearrangement of industry between manufacture and trade, and agriculture; and on comparative property values.

It is true that in this light the prospects for wealth do not glitter. But we are likely for the next twenty years to talk more of making a living and less of making a fortune, and society will be the healthier for it.

One would think that the combination of capital might secure the monopoly of the cutlery market — that it would be impossible for a man without capital to maintain himself against Sheffield and Meriden and Shelburne Falls; yet F. A. Seaver and son of Lake Mills, Jefferson County, in this state, carrying their steel and wares back and forth over-land seven or fourteen miles, with next to nothing for capital, can make a living, and have a nice little margin to spare, on the single article of butcher knives. The reason is because they bring to every piece that leaves their hands an amount of personal care and skill that cannot be secured in the great establishments.

Within six months a tinner has come to the suburb of Chicago in which I reside — the last place where you would have said such an artisan could get a living — and has been more than busy every day since his arrival. Personal facileness in his art is the secret of his success.

Mass capital and lose genius in manipulation is the rule.

The civilization that depends on massing its capital and is not alert to foster native talent, sporadic in its appearance as it may be, goes to the wall.

It will take only a little more loading cloth with starch, earths, gums and dyes, on the part of the factories to make it profitable to bring the old hand looms out of the garret to make cloth once more that would go from year to year, if not from generation to generation.

Capital, in its combinations, has pushed out so far in many directions that it can sustain itself only by fraud, and fraud is an inverted pyramid.

When ninety-four per cent. by weight of silk is dye to six per cent. of fibre, it will become profitable and popular to wear hand-made cloths instead of such silks; and the process of making them will be as fashionable as worsted work, perhaps even as fashionable as painting in water-colors.

I believe the remedy of our present industrial stagnation is to be found in just the opposite direction from that we have been pursuing. Instead of trying to make great combinations in which the care shall be loaded on a few individuals, we shall go back to our local enterprises and put in some care for them. Instead of trying to find some Rothschild — shall I say Jay Cook & Co., Duncan, Sherman & Co., Ralston, Winslow, Spencer, Tappan, some treasurer of a Fall River manufacturing company, or other of "the noble army" of huge bankrupts, innocent or malicious, whose debris, or the plentiful lack thereof, lie around us "thick as autumnal leaves that strow the brooks in Vallombrosa;" — to take care of our funds, we shall see if we really cannot trust our neighbor and help some struggling enterprise in our own village.

It is said that small enterprises are unsafe and go to the wall soonest. This is partially true and partially false — and when it is true it is not necessarily true. It will take a great many of these small failures to aggregate the amount lost in banking, insurance, by treasurers of companies and corporations, and officers of railroads.

When it comes to loss it is just as comfortable to reflect that you have tried to help some humble affair as that you have gilded the hegira of some of the great financiers.

Since the dawn of history there has been a contest to secure the definition of *political* rights. That contest is pretty much ended in civilized nations. The overthrow of slavery and serfdom demonstrates the basis on which political rights must hereafter rest. But while *political* rights are taking their final form, *industrial* rights are still in a nebulous condition. We are in the latter about at the point in the former of the secession of the plebs from the patricians.

We have yet all the weary way from Mons Sacer down, to travel.

Do you think, Mr. President, that we are seeing the beginning of the end in the labor agitation? I tell you, nay, we are only seeing the beginning of the beginning.

There will yet be a readjustment of values as radically different from any thing that now prevails as steam transit from the footman.

Take a yard of cotton cloth, if you please, and reason about it a little.

There will be no quiet in the industrial situation till the price of a yard of cotton cloth approximates to that of a bushel of corn, perhaps of a bushel of wheat; unless utterly undreamed of inventions and conditions are worked to modify the labor of its production.

Though we have given political freedom to the slave, we have not yet touched his *individual* condition.

The price of the production of cotton is still at a point which represents the absolute chattelhood of labor. That will not stand.

In the manufacture of cotton we are working on an inversion of the family relation, and that will not stand.

The condition of no great manufacturing interest will be stable that rests on the labor of women and children.

The cotton cloth finds its way to market over railways.

Last summer the transportation business was brought to a sudden halt, the operatives said, because they could not support families on their wages. Blind and foolish these operatives were; but thousands of men do not enact blind folly without the compulsion of some master grievance.

This is certain — no men are more closely worked and more closely paid than railway operatives.

The remedy against the troubles of last summer was in prominent quarters maintained to be the employment of none but unmarried men.

Now look at the condition of things revealed by a yard of cotton cloth. Here are three great departments of industry — original production, manufacture, and distribution — which are carried on, or sought to be carried on, in flat violation of the family relation or in indifference to it. Yet we are all agog with wonder to know where communism comes from. Its origin may be suspected not to be altogether due to the outcropping of original sin in the laboring man.

As if we had not degradation enough in our own labor, we are invited by some capitalists to put labor down to the level of the Chinese system.

If there is any one gauge indicating the superiority of our civilization over that of the Chinese, it is the cost of supporting women and children. The Chinese works so cheaply because he expends next to nothing in the support of wife and child. I believe it is understood that most of the women who have accompanied our cheap Chinese laborers to this country are not in the marriage relation. That is the one main reason of the cheapness of Chinese labor.

The cost of the Chinese wife is at the rate of the simple support of the animal woman. As between the wisdom of the hoodlum and that wisdom which would solve the labor problem by remanding woman to the position she holds among the Chinese emigrants, commend us to the former; it is not so earthly, sensual and devilish.

The end of our difficulties will not be by communism as disruptive, nor by the bullet as preservative of the old order. Neither will settle anything. The one is as irrational as the other. We shall begin to build well when we discern what has gone to pieces under us. It is clear that the present condition of things has brought into derision the political economy which has paraded its columns of statistics — the tombstones of dead acts — as the gauge of human possibilities; which has taught us that there is only one principle — competition — the law of demand and supply, which presides over the regulation of labor.

That political economy sounded very well in the mouths of doctrinaires. But society is breaking up under it, capital is shriveling, and labor idle, incommunicative, sullen. We have excellent scientific authority that the will amounts to something in the modification of environment.

The statement might have been added that the extent and quality of modification depends on the intelligence and moral intent.

Given these in high degree and of pure tone and all things are possible. Given these and we shall cease to speak of labor as a commodity. It is not commodities we are talking about, "but human creatures' lives." A remarkable commodity this which requires a national army and a state constabulary and local police to keep it from appropriating all the dear earned possessions of man. The end of that wisdom is anarchy.

We have reached in practice this demonstration: You cannot found civilization, preserve capital, organize labor, carry on any of our industrial or commercial functions, simply by the guidance of the self regarding instinct.

NOTE.— The following item from "The Christian Union," I append to the foregoing essay for reasons that will be apparent on its perusal:

"INDEPENDENT LABOR.— In spite of the multiplication of machinery there is still a strong prejudice in favor of hand-made articles of all sorts, and therein lies a suggestion that may relieve much of the distress that now causes such wide-spread dissatisfaction with the existing state of things. The 'Scientific American' says:

"The chronic superabundance of the labor supply in the older countries had developed some conditions full of useful suggestions to us. Wherever we travel, there we are surprised to learn that a large proportion of the smaller articles of manufacture, with which, in some instances, the trade of the world is supplied, are made by artisans in their own houses and with the simplest appliances; and we find there also, in almost every large town or city long established, business houses whose sole business it is to receive and distribute these goods, to find markets for the handiwork of the independent workman. We know of prosperous firms in England who do a very extensive trade in this way on an investment probably of not more than $10,000. Obtaining samples of their productions from the various artisans so employed, they intrust them to their 'drummers' or 'commercial travelers,' who travel in every direction exhibiting them and soliciting orders; on receipt of an order the special workman is notified, and soon makes his appearance with his basket or bundle of goods, which are inspected and paid for according to previous agreement. The goods are then put up in the conventional packages and shipped according to order.'

"The individual workman may thus compete with the corporations, but he can only do so by producing an article which will possess some superiority over the product of machine work. If in addition to this he can avail himself of associated means of disposing of his work, he may create an independent market for his goods." C. C.

DISTRIBUTION OF PROFITS.

A NEW ARRANGEMENT OF THAT SUBJECT.

BY PROF. A. O. WRIGHT.

The following is offered as a new arrangement of the subject of distribution of profits, differing in some important particulars from the arrangement given in any work on political economy with which the writer is acquainted.

In civilized communities nearly all Production requires the union of capital and labor. The proceeds of production are then distributed in various ways between the capitalist and the laborer. In actual practice the capitalist and the laborer may or may not be the same person; but in theory we may separate the shares of capital and labor. There is still a third party concerned in production, the business manager, who stands between the capitalist and the laborer, and by his skill in superintendence increases the proceeds of the business, and thus makes himself a sharer in the proceeds.

The share which always belongs to the capitalist is called interest, when it is paid for the use of money, and rent when it is paid for the use of real estate. The rate of interest and the rate of rent vary according to fixed laws which I need not give here. The share which always belongs to labor is called wages (or in some cases salary). This also varies according to well-known laws. After deducting interest or rent, as the case may be, and wages, including the salary of the business manager, the net proceeds are the real profits of the business. In some cases instead of profits we should say losses, but this does not change the conditions of the problem. Whoever receives the profits should also bear the losses, and generally does. There are then two questions in regard to every kind of production: first, what are the profits (or losses); and second, who gets them. In solving these questions I make the following five cases, each of which presents a different phase of the question :

CASE I.

In this case, capitalist, business manager and laborer are combined in one person. Examples of this case are farmers who own land and furnish their own labor; mechanics who own their own shops and tools and do their own work; and merchants who own their own stores and stock in trade, and keep no clerks. This case is the simplest in practice and the most difficult in theory. As one person combines the functions of capitalist, business manager and laborer, there is no distribution of the proceeds. No one pays interest or wages to himself. The question, who gets the profits, is easily answered. But the question, what are the profits, is much harder to answer, and indeed the producers who come under this class rarely attempt to answer it. They confuse together interest, wages and profits in one lump sum, and often fail to separate their personal or family expenses from the expenses of the business, or to account for the proceeds of the business which they or their families consume.

To find the true profits of such a business, not only should all business expenses be deducted from the gross proceeds, but also interest on the capital invested and wages for the labor done. The farmer, mechanic or merchant, as the case may be, owes himself as a capitalist interest on the capital invested. He also owes himself as business manager and laborer, wages for labor performed. But all products of the business consumed in his family should be added to the gross proceeds of the business, and charged to family expense account.

In this case a real business loss is frequently concealed under the profits of capital and labor. The producer thinks he has made so much out of his business, when in fact the business has made nothing, and his receipts are really less than interest and wages should be. So also a real business profit is frequently concealed under extravagant personal or family expenses.

But it does not always follow that a farmer is losing money who does not clear the interest on his land and stock, and wages for his labor. He has the advantage, if he is free from debt, of receiving interest without the trouble and risk of lending money or renting a farm, and he has work all the year round. He can put in odd hours and days of labor for himself where he could not in working for some one else. The great advantage of small farms held in fee simple is that more work can be put on them than could be done by hired labor. This is an advantage both for the farmer and for the whole community, as the case of France since the revolution shows.

CASE II.

In this case capitalist and business manager are the same person, employing one or more laborers. This case differs from Case I only in the employment of laborers; and as a farmer's, mechanic's or merchant's business grows, it naturally runs into this case.

In this case there is no distribution between capitalist and business manager. The net profits of the business are found as in Case I, except that the labor is partly or wholly paid for, according as the proprietor himself works or not. This payment of labor thus makes wages visible as a business expense. But the proprietor's own labor, as manager or laborer or both, must be accounted for as in Case I.

The remuneration of the laborers hired is generally (a) wages. But it may be (b) a share in the gross proceeds or in the net profits, or (c) partly wages and partly a share in the proceeds or profits. As the gross proceeds are so much more easily estimated than the net profits it is found in practice usually better to give a share in the proceeds in those cases where the laborer receives a share of the results of the business. Thus on the cotton plantations in the south, since the war, the negro laborers are often given a share in the crop, a thing which they can easily understand and in which they cannot easily be cheated; whereas if they are to have a share in the net profits it would be easy to cook up the accounts so as to cheat them, and with the utmost honesty on the part of the planter it would be hard for him to make the negroes understand the accounts he kept. But the simplest and most obvious way is to pay the laborer wages, reserving to the proprietor interest on the capital invested, salary as business manager, wages as far as he performs labor, and the profits, if there are any. In many kinds of business it would be hard to introduce any system of sharing the profits with the laborer. Thus in a printing office, where the workmen are constantly wandering from one office to another, or on a farm where in harvest and threshing extra men must be hired, or in a store where the amount of sales and the net profits are both matters that often must be kept secret from the public and from rivals, — in all these cases it would be hard to introduce any system of giving the laborer a share either in the proceeds or in the profits of the business. But where such a system can be introduced it has obvious advantages over the system of wages. It produces a greater interest in the business on the part of the laborer and therefore more faithful work and greater care to prevent waste. It is the usual practice in the great mercantile houses to give the best clerks a partnership, that is, a share in the profits. The hope of this is a constant incentive to the younger clerks, and the offer of a partnership prevents the best clerks from carrying their customers to rival houses or setting up in business for themselves.

CASE III.

In this case the capitalist employs the business manager and the laborer, giving them (a) wages or salary, (b) a share in the profits or (c) a combination of the two. The capitalist takes interest, and the net profits (or losses) of the business. In this case the interest is concealed by the profits, but can be easily separated.

Thus if a capitalist builds a woolen mill, and employs a superintendent and several laborers, he usually pays a salary to the first and wages to the secoud. But he may give the business manager a share in the profits, thus virtually making him a partner. Or he may make him formally a business partner, reserving the title to the mill, and rent for it, to himself. Or he may give both the superintendent and the hands a share in the profits. The usual practice on a whaling ship is for the owner to receive one-half the oil and whalebone, and for the other half to be divided among the captain and crew, in so many "lays," or shares to each.

A variety of this case is where the capitalist is a corporation, as in the case of a railway company, an insurance company, a national bank, a city newspaper or a manufacturing company. In this case interest and profits combined appear as dividend. In a large corporation there are often several business managers, each with his department of the business. Very generally the managers are also stock-holders, and receive dividends in that capacity as well as salaries as managers.

The questions raised by the subject of stock companies and their dividends, are important questions in Distribution. But they call for a separate treatment, and are omitted in this paper.

Another variety of this case is when a number of persons are associated so carry on a co-operative store. Usually the capital of each partner is quite small; but for the purpose of carrying on the co-operative store they are capitalists, even if they earn their living as laborers. They simply club together their individual savings, so as to make a mercantile association, and then employ a manager and clerks, and sell to one another and to outsiders on such terms as they choose to offer. In England these co-operative stores have been quite successful.

CASE IV.

In this case the manager carries on the business, borrowing money or goods of the capitalist or renting land or buildings of him and employing laborers. In this case the distribution is, to the capitalist interest or rent, to the laborer wages, and to the manager salary for his services and the net profits (or losses.) It should be noted that the case is very rare where the business manager can borrow money, buy goods on credit or rent land without capital of his own as a basis of confidence. On that capital he should also have interest.

The best example of this case perhaps is the system of agriculture in England. There the capitalist is the landlord, who rents land for a term of years, generally now for twenty-one years, under definite conditions in regard to crops and improvements, and for a fixed rent in money. The business manager is the farmer, who receives salary for his services, interest on the capital he invests in the shape of stock, tools, improvements on the land

and advances made to the laborers before his crops are sold, and the profits (or losses) of the business. The laborers receive wages, often miserably inadequate.

A very common example of this case in this country is where a merchant as business manager invests a small capital and buys goods systematically on credit, renting a building and hiring clerks. In this instance the capitalists are the owner of the store who receives rent, and the wholesale dealers of whom goods are bought on credit, who receive interest directly, or indirectly in the enhanced price of the goods, and perhaps also the bank of which the merchant secures accommodation loans from time to time, paying a high rate of interest. The business manager is the merchant who receives interest on the capital he has invested, salary as business manager, wages as salesman, and the profits (or losses) of the business. The clerk or clerks receive wages. I need not say that the result of doing business in this way is in nine cases out of ten a net loss, which falls either upon the merchant or fully as often upon his foolish creditors, the wholesale dealers.

A variety of this case which almost deserves to be set off as a case by itself, is when the business manager gives the capitalist a share of the proceeds or of the net profits in lieu of interest or rent. The most familiar example of this is where a farm is rented on shares. This is the usual method in the United States of renting farms, when they are rented at all. It is also, under the name of Metayer rent, the usual method in France and Italy. In this method of carrying on business, the distribution to the laborer is wages; the distribution to the capitalist is rent in the form of a share of the crop, which on the average of years is more than a fair money rent. But this is usually more than offset by the tenant's neglect to keep up the land, as he holds only from year to year. And the distribution to the business manager who in this case is the tenant, is interest on the capital he has invested, if any, wages for his own labor and net profits (or losses) after paying any laborers he has hired and giving the landlord his share of the crop.

CASE V.

In this case an association of laborers borrow capital and employ a business manager who may or may not be one of their own number. This case is a favorite one with many persons in theory, but it has never thus far been found to work well in practice. To avoid misconception, it should be noted that corporative stores do not come under this case· The laborers who organize a corporative store, do not as a rule work in the store, and are therefore in regard to that business not laborers, but capitalists. They are really a stock company to carry on a mercantile business and therefore come under case III. as we have already seen.

But when journeymen shoemakers, for instance, form a co-operative association, they come under this case. As in all kinds of business, capital is needed to begin it and to carry it on. This capital may possibly be obtained in one of three ways: (a) By borrowing money of some capitalist, which could not be done ordinarily; or (b) by renting a shop and buying materials on credit, a hazardous undertaking both for the association and for the capitalist; or (c) by combining their separate earnings, which would be the usual method. In this case the association as a combination of capitalists employs its own members as business manager and laborers.

This case in the last form differs from case I only in being the case of a combination of individuals instead of a single individual, that combine in one the three functions of capitalist, business manager and laborer. But in this case, while there is no distribution between the association and outsiders, there is a question of distribution between the members of the association. Of the various methods which might be adopted, the following is the most in accordance with the principles of political economy. Let the members be credited with the capital advanced by each as so much stock in the association; let the members be paid for their services at the market rates, and if possible, by the piece and not by the day, and after paying these wages and other expenses, let the members divide the profits or losses on the basis of the capital advanced by each, like any stock company. All these five cases have their place in the transactions of business, and every form of productive industry must fall under some one of them. I summarize them in closing:

Case I. Where the same person is capitalist, business manager and laborer.

Case II. Where the capitalist and business manager are the same person, employing laborers.

Case III. Where the capitalist employs the business manager and laborers. All business corporations are a variety of this case.

Case IV. Where the manager carries on the bnsiness, borrowing or renting of the capitalist and employing laborers.

Case V. Where an association of laborers employ themselves and furnish their own capital.

WEALTH, CAPITAL AND CREDIT.

By J. B. Parkinson, of Madison.

Macleod in his "Theory and Practice of Banking" asks why political economy has not yet attained the same rank as an exact science as mechanics, and answers, "because the same care has never yet been given to settle its definitions and axioms." In this answer we are furnished with but a fraction of the truth. A deeper reason is, its definitions and its axioms are far more difficult of settlement than those pertaining to mechanics or to any of the more exact sciences.

Political economy labors under special disadvantages. Its close relation to the moral sciences, whose circles certainly touch if they do not overlap, brings it continually into contact with feelings and prepossessions which are nearly sure to leave their impress upon the discussion of its principles. Its conclusions, too, from the very nature of the subject matter of which it treats, have a direct and visible bearing upon human conduct in some of the most exciting pursuits of life, while its technical terms by a sort of compulsion are taken from the language of the people, and must partake in a greater or less degree of the looseness of colloquial usage. Its growth seems slower than it really is, for it belongs to a class of sciences whose work can never end. The chief data from which it reasons are human character and human institutions, and whatever affects these must continually create new problems for its solution.

Of disputes about definitions there is no end. They are rife in every science. In political economy they are especially so, and chiefly for the reasons above stated. Disputes of this character are usually harmless, and not uncommonly stale and unprofitable. But there *are* economic questions of vital import, such as reach to the very essence of things, about which we do not find that harmony which would seem to be essential to healthy and rapid progress.

The subject to which I desire to call attention chiefly at this time is credit, but before doing so, it is important to pass in brief review two or three other terms which lead up to and are necessarily involved in any discussion of credit.

The first of these is value, an important term in Political Economy, and one almost necessarily concerned in every economical discussion. A misapprehension of the nature of value will vitiate all reasoning upon questions of economy and finance. The term is a relative one, and herein lies the chief difficulty. That which is absolute the mind can seize and hold, but mere relations are apt to slip the grasp at every turn. Value always implies a comparison. It is the relation which one thing bears to another as made known by an act of free exchange. In other words, exchange, which is a sort of equalizing of estimates, alone gives expression to value. It would be just as reasonable to attempt to determine a ratio by considering one of its terms only, as to attempt to ascertain the value of a thing without comparing it with something else.

Another term closely allied to value, and which is made the central word in most of the definitions of political economy, is wealth. This, also, like other terms which this science is compelled to use, is taken from every day language, and is sometimes employed in a vague, and often in a metaphorical sense. "Every one," says J. S. Mill, "has a notion, sufficiently correct for common purposes, of what is meant by wealth. The inquiries which relate to it are in no danger of being confounded with those relating to any other of the great human interests" While this is true, yet, as Mill himself shows, the most mischievous confusion of ideas has existed upon the subject, which for generations gave a thoroughly false direction to the whole policy of Europe. Under the so-called "Mercantile System," nations in their intercourse with each other assumed, either expressly or tacitly, that money and the precious metals capable of being converted directly into money were alone wealth — that whatever sent these out of a country impoverished it, whatever tended to heap them up in a country added to its wealth, no matter what or how much of other commodities was given in exchange for them. These crude notions have in the main been dissipated, yet some traces of them still linger and often crop out in discussions upon what is called the balance of trade. Disputes about wealth still go on, but they are mainly over distinctions of metaphysical nicety. Political economists are substantially agreed as to the nature of the thing itself, and only quarrel about whether this or that shall be admitted to the category. In the language of the logicians, they differ about the term in extension, not in intension.

Prof. Perry, however, holds that it is impossible to frame any definition of wealth which will render the word fit for scientific use. He has written a book about wealth without stopping to define it. It is a work of much merit, but is marred, it seems to me, by the author's persistent attempt to ignore this term. Nothing is gained by calling political economy the "science of exchanges," or the "science of value." The question What is wealth? must still be met, for to wealth only do exchanges apply or does value attach. Wealth is usually defined, and I have no new definition to offer, as "anything which can be appropriated and exchanged." The essential requirements are that it shall possess utility, or the capacity to satisfy desire, and be the result or embodiment of labor. Hence, as a generic term, it includes all objects of value and no others. It is usual to include in wealth material things only — such as may be accumulated, stored. Such limitation is more in accordance with the popular notion of wealth, although strictly and logically the term includes more. The question of wealth or not wealth does not absolutely turn upon the length of time a thing may be enjoyed, nor upon whether it may be seen or tasted or handled. The primary source of wealth is the free bounty of nature. The secondary source is labor which also gives the right of possession. Nature is liberal in her gifts, but she rarely offers them in a condition just ready for man's consumption. Man begins where other animals end. They use nature's gifts as they find them. He, like them, partakes of her fruits, but is expected to fit them for his use by rational effort. The accumulated wealth of the world is but the result of the application of labor to the materials furnished at free hand. Wealth and capital must not be confounded. The former includes all objects which may be appropriated and exchanged, the latter, such only as may be employed in production, or at most, such as are set aside for productive purposes. Hence, all capital is wealth but all wealth is not capital. Wealth is generic, capital is specific. Capital is sometimes called labor of the past. It is the result rather of the combination of past labor and natural agents. The knowledge and skill of workmen also are by some included under the head of capital. There are grave objections to such a classification. It tends to break down all distinction between capital and labor, or rather, between capital and laborers. All labor implies a union of physical and intellectual effort, and the same reasoning which is urged in favor of reckoning the acquired knowledge and skill of the laborer as a part of capital would, if followed to its logical results, include his physical strength also in the same category. It is claimed that men sell their skill — their intellectual and physical dexterity. If this be true, then they also sell their mere physical powers. The truth is they sell neither. The *results* of each are bought and sold in the market — not these powers and capacities themselves. It is a characteristic of the latter that they are retained and used — not parted with at all. Nor is the skill of a mechanic, strictly speaking, something owned. Possession implies something outside of the possessor. Knowledge and skill and physical power go to make up the man,— they are a part of what he *is*, not what he *has*. Labor helps to create capital, and the powers of the laborer, whether natural or acquired, are potential labor.

We are now in a better condition to understand the nature and chief functions of credit As the etymology of the word signifies, credit is trust — confidence. Prof. Fawcett defines it as "power to borrow." From the standpoint of the borrower this is correct, but back of this power and essential to its exercise is the trust imposed by the creditor. In its generic sense, credit is implied in all mutual dependence and mutual helpfulness. Without it, society would be impossible and human intercourse practically at an end. As applied in the affairs of life, credit is reliance on the integrity, energy and skill of one's fellow men, and the extent to which it may be safely carried is one of the highest

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tests of civilization. It is neither wealth nor capital — does not of itself create either. It brings wealth into the form of capital and thus gives experience to the industrial talent of a country. All written instruments of credit, when in use, whether in the form of book accounts, bank bills, checks, bills of exchange, or what not, are tangible evidences that trust has been imposed and that the power to borrow has been exercised. But credit may be signified by spoken words, as well as by written, or even without the use of either. Prof. Perry says "credits are debts not yet realized," meaning probably that instruments of credit are evidences of rights not yet realized, and obligations yet unfulfilled. Credit creates rights and rights imply obligations. The terms are reciprocal.

All this seems plain enough, but it is only by holding fast to elementary truths that we can hope to reason clearly upon any subject. More fallacies cluster about and take root in the subject of credit than in any other within the whole range of political economy. They find expression everywhere, but especially in language and legislation connected with taxation and the currency. Chief among these is the notion that evidences of debt are wealth. It seems to me that some political economists of high standing are not wholly free from responsibility in this matter. Even John Stuart Mill, who usually weighed his words with great care, has used language in the preliminary chapter of his "Principles of Political Economy," which even taken as a whole, if not absolutely inaccurate, is difficult to reconcile with his own teachings elsewhere, and is certainly misleading. He attempts to draw a distinction between wealth as applied to the possessions of an individual and to those of a nation or of mankind. "In the wealth of mankind," he says, "nothing is included which does not of itself answer some purpose of utility or pleasure. To an individual anything is wealth which, though useless in itself, enables him to claim from others a part of their stock of things useful and pleasant. Take for instance a mortgage for a thousand pounds on a landed estate. This is wealth to the person to whom it brings in a revenue, and who could perhaps sell it in the market for the full amount of the debt. But it is not wealth to the country; if the engagement were annulled the country would be neither poorer nor richer. The mortgagee would have lost a thousand pounds, and the owner of the land would have gained it. Speaking nationally, the mortgage was not itself wealth, but merely gave A a claim to a portion of the wealth of B. It was wealth to A, and wealth which he could transfer to a third person, but" — and here comes in a saving clause which contains the essence of the whole matter — "that which he so transferred was a joint ownership, to the extent of a thousand pounds, in the land of which B was nominally sole proprietor." The public funds of a country are in precisely the same category. Mr. Mill says they cannot be counted as part of the national wealth, but intimates in one breath that they are a part of individual wealth, and in the next wipes out the distinction. They are not real wealth at all, neither national nor individual. The fundholders are "mortgagees on the general wealth of the country;" the funds indicate liens upon that which is real and tangible, to be drawn ultimately from the tax payers of the nation. Mr. Mill also gives countenance to a distincton between the wealth of a nation and that of mankind. "A country," he says, "may include in its wealth all stock held by its citizens in the funds of foreign countries, and other debts due to them from abroad." But, as if not quite satisfied with this statement, he adds, "even this is only wealth to them by being a part ownership in wealth held by others. It forms no part of the wealth of the human race."

There is in reality no distinction between the wealth of an individual, of a nation and of mankind. Individual wealth is and must be a part of national wealth, and national wealth is and must be a part of the wealth of the human race. If the context were always carefully read in explanation* of the text, Mill might perhaps be safely allowed to answer Mill. As it is, his insufficiently guarded words at this point have helped to perpetuate the thousand and one fallacies which find expression in discussions about currency, banking and taxation.

Professor Perry has taken his stand without qualification on the economic theory that credits, rights, claims are property, meaning by property wealth or capital. The term property is an exceedingly ambiguous one. Not to speak of its various secondary and metaphorical uses, it is employed in two important and totally distinct senses. In a purely legal point of view, it is the right or title to a thing — ownership. But in the more common and popular sense, and the one in which alone political economy is concerned about it, it is a tangible entity — the thing owned — that upon which the claim is based — that in which the right or title inheres. In this sense there is no difference between property and wealth. "The test of property," say Professor Perry, "is a sale; that which will bring something when exposed for exchange is property; that which will bring nothing, either never was, or has now ceased to be, distinctively property." But Professor Perry holds that credits, rights, claims, are property; that property is or may be capital, and that all capital is wealth. It seems to me there is a fallacy here, and that it lies in considering that what are bought and sold are mere rights and claims, separate and distinct from the entities in which the rights inhere, and to which the claims attach. Strike the property out of existence upon which a claim rests, and the claim disappears with it. Destroy a man's claim, on the other hand, or all evidences of it, and the property remains — the ownership simply changes hands.

If titles are property in the sense of wealth, it would seem that a community has an easy road to fortune. Its farms and other real estate are wealth; they need only be mortgaged to create as much new wealth in the form of personal property. If mere titles are property, then the wealth of the nation or, is you please, of the individuals of the nation, may at least be doubled without any appreciable expenditure of time or labor. The truth is, wealth is something valuable and which has become so through the application of labor, and a title to it, or a claim upon it, or a representation of it, can no more be wealth than a shadow can be substance.

The notion that titles and claims are property finds ample expression in tax-laws. Few countries afford better opportunities for testing methods of taxation than our own, but none certainly can exhibit such an array of incongruities. The ease with which property is accumulated makes us less considerate of expenditures and leakages. Under the plea of equalizing the burden, our general theory seems to be to tax everything without inquiring whether it be a symbol or a reality, a lien upon a thing or the thing itself. The result is, the very inequalities we would obviate are aggravated. If political economists of high standing insist not only that real estate is property, but that mortgages upon it are also property, is it strange that legislatures enact that each shall be taxed? Touching this question, the conclusion of Judge Foster, set forth in his dissenting opinion given in the somewhat celebrated case of Kirtland vs. Hotchkiss, heard before the Supreme Court of Errors of the State of Connecticut, seems almost axiomatic. He said:—"Property and a debt, considered as a representative of the property pledged for its payment, constitute but one subject for the purpose of taxation. The tax being paid on the property without diminution on account of the debt, nothing remains to be taxed. The debt, indeed, aside from the property behind it, and of which it is the representative, is simply worthless." We may call what we like, property or wealth, and governments may determine that all property, including imaginary things and legal fictions, shall be taxed, but nothing short of omnipotence can make something out of nothing, or collect taxes from symbols. "It is property in possession, or enjoyment, and not merely in right, which must ultimately pay every tax."

Rights and titles and claims are elements in the distribution of wealth, not in its composition. They attach to pre-existing property and may be multiplied indefinitely. Any tax upon them is only another means of burdening the property that lies behind them.

But it is in connection with the currency that credit wields its chief influence, and may work its greatest mischief. Leading writers upon political economy and finance have done much to instill correct notions of money and its various credit substitutes, and their responsibility in this direction can scarcely be over-estimated. In this light, it is at least an open question, whether the views of Professor Francis A. Walker, as set forth in his late work on "Money," and also in his later one on "Money, Trade and Industry," do not give some encouragement to the numberless fallacies that are afloat upon this subject. Professor Walker has done excellent service in the economic field. He always writes with clearness and vigor, and whatever he says upon any topic is sure to command attention. "Money," he says, is that which passes freely from hand to hand throughout the community, in final discharge of debts and full payment for commodities, being accepted equally without reference to the character or credit of the person who offers it, and without the intention of the person who receives it to consume it, or enjoy it, or apply it to any other use than in turn to tender it to others in discharge of debts or payment for commodities." This is an almost faultless description of money as a fact, and if we were dealing with facts only and not with their interpretation, it might be allowed to pass without comment. The core of this description lies in the words "final discharge of debts and full payment for commodities." In their correct interpretation rests the whole matter in dispute. In the view of Professor Walker the question, money or not money, is, in respect to anything that could be taken, wholly a question of degree — the degree of the extent and facility of its use in exchange. If the thing be a paper promise, another distinction is called in, which is that the promise must be that of somebody else, and not of the one who offers it. "If I purchase a farm from any one," he says, "and give him my promise to pay him at some future date, that promise, whatever form it takes, whether written on paper or stamped upon brass, whatever my character or competence, whether I be rich or poor, honest or dishonest, is not money. The goods are not yet paid for, but are yet to be paid for. I have taken credit; I have not given money. The seller still looks to me for the equivalent of the goods he has parted with. * * * I buy a horse, and give the owner thirty $5 notes. Have I taken credit? Not at all; I have paid for the horse. * * * He takes the notes from me because they are money — that is, because they have such general acceptance throughout the country that he knows men will freely and gladly take them from him whenever he wishes to buy anything."

As a matter of fact, the credit element enters into both of these transactions. In each case it is between the maker of the promise and the receiver of it. In the one case the promise is made directly to a particular person, in the other it is made to bearer. In the one case the maker is an individual, in the other, a collection of individuals or corporation. In each case the maker of the promise is held under the law, more or less perfectly, to its fulfillment. According to one distinction made by Professor Walker, neither the bank bill nor the promissory note is money, as between the bank or the individual maker and the holder of the bill or note. But between other parties and according to the other distinction, which turns upon the degree of currency, he holds that the bank bill is money, and the individual note not money. But a man may be so widely known, his integrity be of so high a character, and his means so ample, that his promise may be just as good and just as current as an ordinary bank note. The one may be called money and the other not. The law may determine that an acceptance of the one shall be a bar to any further recourse upon the party from whom it is received, and that an acceptance of the other shall not be such a bar. All this lies close to the surface. It does not reach to the root of the matter. The question, money or not money, can never turn solely upon the "degree of currency" of the thing in use. This depends upon time and place and other circumstances, and attaches even to gold and silver as well as to the different substitutes. The distinction lies deeper. Money pays, but every paper substitute bears upon its face the evidence that it does not pay in the full and complete sense of the term.

But, says Professor Walker, "to say that a bank note is a promise to pay money is to beg the question. A bank note is a promise to pay gold or silver, and therefore, if you please, is neither gold nor silver; but wherefore not money? Money is that money does; and the bank note performs the money function in every particular." In this last sentence he himself begs the question, and, although unintentionally, gives aid and comfort to the advocates of "fiat" money. The bank note promises to pay francs or pounds or dollars, and these have a definite and well understood meaning. They are a "material recompense or equivalent" — are wealth and really pay for wealth. Money proper conforms strictly to Prof. Walker's own description; promises to pay, or orders to pay, of whatever name or nature, do not so conform. Money passes from hand to hand throughout the community in final discharge of debts and full payment for commodities by no magical process, nor because it is called money, or declared to be money by an edict of the government, but for the reason that it is a complete equivalent. Bank bills, promissory notes, checks, and various other credit instruments, take the place of money in part by serving some of its purposes, and it is because they do so that they become so dangerous in actual use, if not properly guarded. But they serve these purposes not through any force of their own, but as representatives. Their energy is not primitive, but derivative. They are not actual equivalents, but claims, only, or evidences of claim, upon that which is an equivalent; and when the principal in whose name they act disappears, their force and authority is gone. Professor Walker, in his whole characterization of money, largely ignores its most delicate if not most important function — that of serving as a measure of wealth or standard of value. Almost anything which the parties concerned may agree upon will serve as a medium of exchange — a bank bill, a check, a note of hand, "a chalk mark behind the door, a notch in a stick, a wink at an auctioneer" — but very few things will serve well as a standard of value. To do so, they must themselves be valuable, that is, be objects of general desire and the results of labor. They must be something that pays as it goes — that walks by sight and not by faith — that, when accepted, leaves no recourse upon anybody, either in law or equity. No credit instruments can fully meet these requirements. The distinction is vital. Ignore it, and the floodgates are open for all sorts of money and all sorts of notions about money.

THE NATURE AND FUNCTIONS OF CREDIT.

A. L. CHAPIN, D. D.

Some exercise of trust between man and man is essential to the very existence of human society. Trust implies two things; first, an intellectual belief in the truthfulness and integrity of one's fellow-men; and second, a blended feeling of dependence and reliance in mutual relations and intercourse. As civilization advances, this element of trust enters more and more into all the various intercourse of mankind, and its extent and the soundness of its basis become a sign of the social condition and moral character of a people.

Credit is but a technical name for the trust which runs through all the manifold processes of productive industry and commerce. It is indispensable to the effective division of labor and to the free and advantageous exchange of the products of labor. It pervades the business operations of men the world over, as that subtile agent, light, pervades the material universe. Its operations are most minute in their details, most magnificent in their range and most grand and sometimes terrible in their results. It seems a very small affair, when the butcher enters on the poor sewing-woman's market book a daily bit of meat, expecting the account to be settled at the end of each week. It is nevertheless an operation of credit, not altogether insignificant to the parties concerned. You look with wonder at the silent manipulations of the bank clerks as they pass in procession along the desks of the New York clearing-house, and when you are told that what is done there in that one still hour of the day adjusts thousands of commercial transactions and redistributes a hundred millions of wealth, you get some conception of the vast complications of this agency we call credit. And when you hear that the nod of the autocrat of the Rothschild's bank, settles questions of peace and war between conflicting nations, you apprehend what a power this agency, credit, is in human affairs.

The word credit is in common use, employed quite vaguely, and the indefinite use of the term has confused the discussion of many economical problems, and led to erroneous opinions. In its correct use, the radical meaning of trust — that mental exercise which includes an intellectual judgment and a feeling of reliance, must always be kept prominent. Credit is always a subjective thing with the man who trusts rather than an objective quality of the man trusted. We speak loosely of a man's credit, meaning something in his character or condition which is a power to command credit. The real measure of his credit is, however, the estimate in which he is held by others. Swindlers understand this very well, and their efforts are never to perfect in themselves trustworthy qualities, but by whatever deceptive arts, to mislead the judgment and to win confidence in their favor. Judgment and feeling are very closely identified in the exercise of credit. The normal exercise requires that the judgment should regulate the feeling, but too often this order is reversed; the feeling runs away with the judgment. Hence over-confidence unduly expanding credit, at one time, followed by the reaction of panic, when unreasoning distrust paralyzes all business activity.

As a technical term in the science of Political Economy, "Credit is Trust in the promise of an equivalent to be rendered at a future time for values immediately transferred." It supposes one of the highest acts of human free-will, a contract between two parties, in which a present advantage conferred is balanced by an obligation to be fulfilled in the future. The possibility of thus entering into a contract and its binding force proceed from two capacities of the human mind, viz., foresight and freedom. For a present consideration, anticipating future resources, a man freely binds himself by an expressed intention respecting a future act, surrendering his right to change that intention. It is evident then that the soundness of credit, the strength of trust, in a particular case or in regard to transactions generally must be determined by the care with which such obligations are assumed and the sacredness with which they are regarded.

The true basis of credit is real wealth, existing or prospective, which is or is expected to be at the command of the party trusted. Credit is never self-supporting. It does not go alone. It can neither walk nor fly. The waxen wings of imagination on which like Dædalus, it sometimes boldly starts forth are quickly melted and its fall is swift and ruinous. Credit must ever and anon feel under it the solid ground of real wealth. The promise must meet the test of actual fulfillment. Thus our first thought recurs again. The essence of credit is confidence in these two things which are its inseparable supports, the truthfulness and the probable ability of the promisor,—a moral and a material property joined.

Money as a commonly accepted measure or standard of value, fulfills an office of the highest consequence in all operations of credit. Except in rare, special cases, it furnishes the terms of the contract. Values immediately transferred are set down in terms of money, which fix the measure of values for the deferred payment. If meantime a change occur in the purchasing power of money, the actual effect of the contract is materially changed to the disadvantage of one or other of the parties. Hence, whatever causes fluctuations in the quantity or quality of money, disturbs credit. That steady, healthful trust which we have seen to be the essence of credit can never be maintained with unstable currency. To this cause mainly we must refer the distrust which prevades the business of our country to-day, and in the midst of of abundant resources paralyzes industry and brings thousands of our stalwart, enterprising people face to face with abject poverty. In the very nature of things, the co-relation between money and credit is close and constant. An unnatural increase in the quantity of that which passes for money by turning certain forms of credit into money, as we saw in the issue of the government greenbacks fifteen years ago, tends to a much greater expansion of credit. The artificial stimulus of this double expansion produces in all business a delirium of intoxication. While the excitement lasts every thing runs wild. But the reaction and collapse are sure to come. We are living now in the day after the debauch. Oh what headaches, what nausea, what exhaustion do we meet on every hand. We wake as from a dream and wonder how we ever suffered our trust to be imposed upon. We look upon the wrecks lying all around and clutch the little we can gather of what is left, afraid to trust anybody more. Would to God this sad experience might open men's eyes to understand the nature of credit and to hold it henceforth within its true limitations under wise regulation.

As I now pass to speak of the functions of credit, I must notice two or three false notions which are more or less current.

1. Credit is not wealth nor capital. It is only a means or occasion for transferring wealth from one to another. A farmer takes from the manufacturer a plow, and gives in return his note payable at the end of six months. When the contract is made, there is but a single item of wealth, the plow. The note given is but the symbol or evidence of its value transferred. Neither the promise on the part of the farmer, nor the trust on the part of the manufacturer has value in itself. The payment of the note, then, is only the return in another form of the one value. If during the period of the contract new wealth has been created, by the use of the plow, it is only as that item of wealth has been made capital, so as in union with labor to become productive. The credit received has merely adjusted the transfer of the one value. Proceeding on the false notion that credit is capital, ninety out of every hundred merchants fail. The false notion still governs the legislation of almost every state in our land, and leads to double taxation, because symbols, mere evidences of debt, are regarded as of the very substance of wealth.

2. Credit does not of itself create capital. It has no original power to make something out of nothing. Wealth does not grow by the mere act of passing from hand to hand. Its increase comes only from its union with labor. The mere multiplying of promises to pay does not make a man rich, as many a deluded creditor has learned to his sorrow. Can a nation, any more than an individual grow rich by that process?

3. The trusted promises of credit in certain forms may be thrown into general circulation, but they are ever simple evidences of debt, and as they pass from hand to hand they do nothing more than transfer the debts for which they were originally issued. This is only saying that an item of wealth cannot be used at the same time by both its owner and the man to whom it

is lent. Sixteen years ago, a woolen manufacturer furnished the United States government with four pairs of army blankets, and accepted in return its promise to pay ten dollars,—the term dollars meaning a certain weight of gold or silver. A., the first receiver of that bill of credit, could have no use of the article he had loaned the government, or its value, till he passed it to another, B., for an equivalent item of real wealth. B. passed it in like manner to C., and so it has been moving on through five hundred different hands, till it has come to me. In every transfer it has just passed along that original debt of the United States government. It is to me just what it was at first, a mere promise of a certain weight of gold or silver to be rendered at some future time. Suppose that to-morrow the government, by word or act should break its contract by turning the word dollars into a mythical term meaning neither gold or silver, or any other form of real wealth, only an ideal something to count by, who then will take it at my hands in exchange for any substance of real wealth? It and the thirty-five millions of outstanding promises like it, would drop like the leaves in Vallambrosa's vale, dead and worthless.

Now to speak more positively, we may define four distinct and important functions of credit.

1. Credit is a most effective means of uniting capital and labor for the production of wealth. It is not itself capital and cannot create capital, but it does greatly increase the sum of wealth available as capital for profitable uses. A thrifty mechanic leaves as the fruit of his life's labor, a large shop well appointed with machinery and tools. But his widow who inherits the estate can do nothing with the property in this form. Across the way, is a young man who has strength and skill and all needed qualifications for business, but is destitute of capital. The widow rents her establishment to the young workman, and so credit joins the labor of the past with present labor for fruitful production and profit to both. But for this interposition, both must have been idle. In every community there are many engaged in active industry who yearly lay by little savings which they cannot use themselves. If there was no such thing as credit, all this wealth,

amounting in the aggregate to millions, must also be idle or be wasted in unskillful and unsuccessful attempts to make it yield a profit. Meantime hundreds of vigorous men must also be idle for lack of this very capital to work upon. Credit is thus indispensable to draw out the entire capital of a country and also to develop most completely the industrial talent of the people. It becomes thus the very spring of industrial enterprise. The sound and healthy exercise of credit, is of the utmost consequence to the laboring classes.

2. Credit quickens exchanges. The plowmaker's winter work gives him a large stock of plows in the spring. The farmers want the plows in the spring, but they are to derive the means of paying for them from the harvest. If no sale could be made till the means of purchase were in hand, business with both parties must be suspended. Through credit the exchange may be made at once. As in this particnlar case, so of ten thousand other things, credit turns them off at once, and capital on every hand is rapidly turned over. It is thus an important function of credit, to keep all the channels of business stirring with life and activity. By it articles are brought within reach just when they are needed. By no other means could the market be kept constantly supplied.

3. Credit serves directly as an instrument of exchange. The simplest phase of this function is in ordinary book accounts. A. buys of B. on credit, and B. buys of A. on credit. At the year's end the books are balanced by the payment of the difference or by simply carrying it over to begin the annual account for the next year. Here exchanges are really made in kind without any of the inconveniences of barter. This is ramified and extended indefinitely, not only between individuals but between cities and nations all around the world, and the greater part of the exchanges is resolved into exchanges in kind. The trade of Milwaukee to-day is mainly an account of credit with all other cities of the country and the world with which she deals. The amount of money invested in these exchanges is insignificant compared with the values which are transferred through this agency of credit.

4. Credit puts every man's wealth at his disposal just when he wants to find and use it. A thrifty farmer finds when his harvests are all gathered in that he has ample provision for his household for a year, and a thousand bushels of wheat beside. He concludes to devote this surplus of his wealth to his own improvement by travel abroad. How can this thousand bushels of wheat be made available for that? What he will really need is the means of locomotion and something to eat and wear, wherever he goes. How shall he get those things out of his present form of wealth? He can't well carry his wheat with him. If he turns its value into money, it will be difficult and dangerous to carry so much gold and silver with him. Credit solves his problem. Through the wheat buyer at home he may pass his grain into the great channel of commerce, and it is made at once the basis of a circular letter of credit which he can put into his pocket in the assurance that in any one of the two hundred cities of the old world named therein, he will find a correspondent of his banker, who, on seeing the letter will furnish him the means of obtaining whatever he may need, asking only that he leave his own autograph attached to a receipt behind him. Possibly he may find himself at a restaurant in Paris eating bread made of his own wheat. However that may be, through this wonderful function of credit, his wheat will carry him about everywhere, supplying all his wants till its value is exhausted. The letter in which he puts his trust, commands for him everywhere the trust of others whom he never saw before and never will see again.

With reference to all these functions of credit, however, it is to be remembered that a basis of sound money is indispensable. Real money is the ballast of the ship of trade. Credit furnishes the sails. Any ballast that easily shifts in a storm is sure to bring danger to the ship. The credit which controls the world and binds all civilized nations together by the interests and mutual service of universal industry and commerce, must be sustained by the all-prevailing presence of money whose value is uniform and stable. Quality in this matter is of more consequence even than quantity. The nation that robs its money of these qualities of stability and uniformity with that of the rest of the world, shatters its credit and rules itself out of free and equal commercial relations with other nations.

Speaking, as I do, in the city of Milwaukee, let me say before I close, that I have been well situated to observe the commercial development of our state, and especially of this city, almost from the beginning. It has been, in the main, a healthy, prosperous development. Our credit has been stable and unquestioned, not convulsed and bankrupted, as has been the case with states on either side of us. Milwaukee, I believe, has stood the severe test of the recent financial revulsion in the commercial world, better than any other western city. Comparatively few failures have occurred. This favorable condition, it seems to me, is due in no small degree to the steadying influence of an institution early established here, almost by an evasion of law, as an agency of credit to meet the ever pressing need of industrial enterprise. When in the phrensied hostility to a paper currency, caused by fraudulent operations of wild speculation, banks were in disrepute and almost entirely disallowed through all this western country, the Wisconsin Marine and Fire Insurance Company, issued its certificates of deposits, and they went into general circulation, because they met an absolute pressing necessity. The institution performed all the functions of a bank without the name. The public confidence had nothing to rest on but the honor and integrity of the managers, who put some real capital into the venture and sought profit for themselves only in identification with the advantage of the community. But there was a basis of solid capital and a great deal of Scotch honesty and thrift in the management, and so the operations were sound, the promises were made good, and the institution greatly aided the rapid unfolding of wealth in our state and in the whole region. It was subjected to more than one fiery ordeal under the efforts of enemies to break it down, but it triumphantly withstood all assaults, and stands to-day in strength and honor, the leading banking institution of our state, identified through all its history, with every branch of vigorous productive industry. If it has brought wealth to its proprietors, it is but a fit reward for what it has done to increase the wealth of the whole community.

I refer to this institution only as an illustration of what sound banking is, and of what it does for the common weal. Banking is simply *the chief agency of credit*, and its true function is at the same time to facilitate and to regulate all operations of credit, so as to draw out to the utmost the resources and energies of a people in fruitful industry. Rightfully managed, on a sound basis, it is an agency for unspeakable good; on an unstable basis, abused for purposes of greed and fraud, it is an instrument of unspeakable mischief.

NATURE AND THE SUPERNATURAL.

J. J. ELMENDORF, S. T. D.

I am somewhat afraid that the subject of my paper may lead some to suppose that I am introducing theological discussion into the transactions of the Academy. If I should fall into this error it will be unintentional on my part, and I beg pardon in advance. Concerning my own views of the truth and meaning of certain wonderful events recorded in documents which profess to be historical, there need be no question. But I do not see that my views on these points need affect the philosophical and scientific problem which I submit for investigation. I propose it in the same spirit as far as is possible, as if the question concerned the history of India, and a narrative of Buddha. Philosophy and science cannot ignore what is immediately around them, viz: a very general reception of certain extraordinary narratives of various kinds; and it is a question to be considered whether there is any case to come before the bar of philosophy or science, or whether these must relegate the matter to another tribunal, since they are incompetent to decide it.

The problem, briefly stated, is this: Inasmuch as nature with its rigid mechanical laws is not inconsistent with the freedom of man, does the admission of the supernatural as an element in the facts which come under our notice conflict with scientific laws, so that it must be rejected at once? or is the sphere of the supernatural, so called, a different one, like that of man's will and reason, so that inductive science may pursue its work undisturbed in its own sphere, leaving the other to its own special students, but accepting conclusions in the moral sphere, as mankind in general accept those of the scientific expert.

From the oldest historical records down to the contemporary witness of some leaders in natural science, concerning wonderful events occurring in England or the United States, we find a series of such marvels recorded, some having a very high degree of attestation in their favor, and some little, if any; the latter chiefly showing a predisposition on the part of many or all to accept the truth of such narratives, which predisposition is itself a psychological fact and demands investigation. But all these narratives have the common ground that they are referable to no well established rules of the phenomenal world which surrounds us, and some of them are so different from ordinary experience as to excite our wonder and tax our powers of belief in the highest degree, even if they are not at once dismissed as unworthy of a rational man's attention.

Some of these facts, so called, are denominated "miracles," and are viewed with reference to moral purposes and treated as evidences of a Divine revelation or of some moral truth. But the events recorded have their scientific relations, because phenomena of nature are said to have been presented to human senses; and they have their philosophical relations, because the asserted facts, whether true or mere inventions of fancy, call for rational explanation. Now my proposition is, that neither science nor philosophy give any antecedent reasons, any *a priori* ground, for rejecting facts of this nature. The question is simply one of their historical evidence, and must be referred to that bar for judgment. When criticism has sifted the evidence and given its verdict, if that verdict be favorable, science may examine the facts so far as the experience of others can be examined; science, *if the antecedents can be repeated*, may verify the results (if the antecedents do not admit of repetition the results cannot be verified); and philosophy will try to explain the facts. If the testimony is rejected as insufficient, there will be no case to come before this court, but the claimant will not have been pre-judged.

And furthermore, that the historical facts should be reconcilable with philosophy and science, it will not be necessary that my view of the case be *demonstrated* to be correct. If only it be a *possible* one, then also the reconciliation will be possible, and my end will be attained.

Let me repeat then, more fully, what I wish to exclude from our discussion: (1) the credibility of the asserted facts; (2) their value, if true, as evidences of any moral or religious truth;

(3) I wish also to exclude any question whether some or many narratives of wonderful events found in ancient and Oriental sources may be presumed to be poetic and allegorical presentations of moral truth, e. g., the story of the tempting of man by a being in the form of a serpent, or that of the Hebrew, Jonah. One single narrative found in the Christian New Testament, and narrated as an actual occurrence, or one of the marvelous experiences of a distinguished English naturalist, is sufficient to determine the question before us.

For the purpose of our discussion, then, it will be expedient to admit, hypothetically, the narrative as a statement of facts which actually occurred, *i. e.*, of sensible phenomena stated, not scientifically, which statement would assign the facts to a known law, but as they would naturally be reported by honest and intelligent eye-witnesses, telling what their eyes saw, their ears heard or their hands handled. It is, of course, at once open to remark from the scientific point of view, that the subjective impression of the phenomenon, together with the ordinary and accepted interpretation of it, is all that any man can report, and for all practical purposes it is sufficient. Philosophy and science proceed further, to some explanation, partial at least, of the marvelous occurrence. For example: if, as one narrative states, the commander of an army made a prayer that the sun might stand still, and the narrative be not poetical imagination,[1] but a historical statement, the phenomenon which followed is all that can be attested. There is not, necessarily, declared to have been a suspension of the sun's daily motion around the earth or any other *scientific explanation* of what the eyes saw.

I.

This being premised concerning historical modes of narration, I must assume some propositions as postulates, without attempting any proof of them; for some are needed, otherwise we could never find a beginning for our investigation.

(1) The world of nature is known to us as phenomena, infinite in number, and, potentially, infinite in variety; phenomena empi-

[1] As in the Chanson de Roland.

rically known, i. e., known only in and through our senses, inner and outer.

(2) Laws of nature are rules for us, the discoveries of our understanding that there is such harmony among the facts as we view them, that they can be classified. These laws are, objectively, *incomplete registers*, extending only to as many facts as have come under our notice; but experience finds them serviceable in anticipating facts of a similar kind. And the *rational* principle of the uniformity of nature, which is given by our reason, and not merely by empirical observation, and which is rationally grounded on the one unchanging nature of the cause which, or the being who, produces the phenomena, and which is confirmed by experience, leads us to expect similar facts in the future. Our confidence being justified, the rule is verified.

But there is room for more, possibly for higher, i. e., more general laws in nature, which may or may not be discovered hereafter. These cannot contradict those already discovered, though in particular application they may appear to contravene the laws already known, by counteracting their results.

(3) It is our *mind*, then, which discovers an underlying unity, an "order of nature," and presumes it where it is not yet proved. This, also, must be deemed to be objectively rational, or the product of intelligence. For what reason discovers is itself rational; our reason connects the phenomena, not arbitrarily, but because of a rational order in them.

(4) Furthermore, such unity, such order, such connection of antecedent and consequent, such mechanical conjunction of parts, such continuity of force (whatever that may be), seen to be always changing in application, but so far as we can discover, always equal in amount; these, on which are based the highest laws of physics, are so invariable that the mind cannot conceive them to be otherwise. We must assume them to be established principles in the existing order of facts. One in old times who believed the facts to proceed from a spiritual source, without any scientific theory of the conservation of energy, said: "With Him is no variableness, neither shadow of turning." And another said: "He hath given them a law which cannot be broken."

(5) A new fact presented to our senses, or duly vouched for, if not explicable by known laws, is not to be rejected. It may hastily be assumed to contradict a law or the order of nature, when, in truth, it is merely incapable of being referred to any known combination of forces. The facts related in connection with what is called "spiritualism," if they were duly attested, would furnish a very striking illustration of this scientific principle.

Contradiction properly applies to universal principles of reason, not to limited empirical rules which may be, and which are, contravened by others. A cause operating with no effect is a contradiction in thought and in words. So is an effect without any adequate cause. But the contradiction is not empirical; for in experience we see apparent failure, and similar effects following upon various antecedents.

(6) I assume, also, as a postulate the existence of spiritual substances, human and superhuman, which are capable of modifying material phenomena, through combinations of what are called material forces (whatever these may be), if not otherwise. (It is possible, indeed, that that purely metaphysical notion called "force," is the sensible operation of that unknown substance called "spirit.")

Natural science may say that the existence of spiritual beings is not proved, not even the existence of spiritual substance called *ego* in man. But neither is their existence disproved, nor can it be. The utmost that positivism can assert, is that their existence is beyond the reach of investigation and knowledge. But since this postulate is not unscientific, contradicts no known principle of nature and reason, and simply begs the *existence* of such beings without a knowledge of their nature, which latter is what positivists dispute, I have a right to employ it as a hypothesis, and this is all that I require, in proving that wonders in ancient or modern times are not antecedently incredible, nor to be rejected as contradicting what we know.[1]

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[1] But I ought to add that this postulate of a free spirit implies that its actions and its laws, even if they can be emperically known, do not strictly come under the province of scientific phenomenal induction, where all seems to be necessitated, and every antecedent to have its invariable conse-

II.

These postulates being premised, I would at once remark that it may be, indeed, possible for the believer in a Creator and Ruler of the world to suppose his immediate interference in the empirical order of the phenomena, his special operation without the empirical antecedents which we ordinarily see in nature. I have nothing to do with that explanation of what are called "miracles." I only remark that the question is then altogether removed from the sphere of science, and no reconciliation, I think, is to be sought for. As a thoughtful scientist once said to me, "I keep my faith in one pocket, my science in another, for I find it necessary to keep them apart." It seems to me strange that truths should be in such an awkward position, especially if any one have reason to believe that empirical laws are the operation of an unseen Ruler of the universe teaching us the invisible things which we could not otherwise comprehend.

But, dismissing the question as not before us, I fail to find in any of the facts, commonly received as true, any need of such a divorce from science. It is now generally admitted, and has been admitted by careful thinkers in past ages also, that nothing occurs *contrary to the order of nature.* I may refer to former believers in what are called "miracles," because they would be likely to deny it if any philosophers did. But Augustine[1] and Thomas Aquinas[2] argue that nothing can happen contrary to the order of nature; for, they say, nature is the product of an unseen Being who can not contradict himself. So I suppose we may hold this as practically undisputed. But the proposition contains a term which calls for definition.

In common acceptation "nature" seems to signify:

(1) The sensible phenomena which we group under the name of matter.

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quent. I grant, however, that we cannot conceive of contradiction between these two, sc., the freedom of spirit and the necessity of nature, or of any violation of empirical laws. I cannot stop to discuss this inference from my sixth postulate; but we must have some common ground to stand on and to start from; I ask for this.

[1] S. Aug. contra Faust., XXVI, 3; XXIX, 2.

[2] Sum. Theol., I, 105–6.

(2) The forces which our mind discovers to be working changes in these phenomena.

(3) The intelligence which our mind also discovers in the unity, order and adaptation of these phenomena when viewed as a whole consisting of parts infinite in number and variety..

Force may be only the operation of an intelligent cause, and so the two latter may be regarded as due to the influence of a spiritual being working in the sensible world. In the *potentiality* of material things are these sensible results, and possibly more which is now inconceivable, but active intelligence may be needed, as Aristotle long ago pointed out, to produce these results. If we thus define nature, when most unusual and marvelous facts are related to us by eye-witnesses, there are various possible hypotheses :

(1) They are brought about by some one whose extraordinary insight into nature's laws places him far in advance of his age, and enables him to produce results which even now we cannot explain; just as if, one hundred years ago, a man in New York had related an audible conversation held with another in San Francisco.

(2) The deeds were superhuman, though not supernatural in any other sense of the word, *i. e.*, according to my sixth postulate, they were such as spiritual beings of a higher order than man may accomplish within the order of nature. Forces, as they are called, were combined to produce results which we may never be able to reach. For example, man can only affect nature, so far as we now know, through his own organism; but there is no antecedent impossibility in the thought of spiritual beings of a higher order having a wider sphere of influence.

(3) The deeds are "*supernatural.*" But here again we meet with an equivocal term. The supernatural, as Kaut points out in his "*Beweisgrund zu einer Demonstration des Daseyns Gottes*" (1763), may be, (*a*) added qualities, properties or forces (which, for our purpose, are one), imparted to substances already in existence.

I have never heard any reason why science and philosophy should pronounce this *a priori* impossible, although it is certainly very improbable, and perhaps removes a fact, however well attested, from scientific thought or investigation. For modern physics seem to show that it would involve a modification of the whole universe, viewed as a mechanism of mechanically conjoined parts, which is very hard to receive.

(*b*) The supernatural means an increment or diminution of some existing force in its relations to others, as if a man were suspended in the air or walked on the water, through his being specifically lighter than he was before; or as if, which as one theologian of high repute asserts,[1] babies are lighter when awake than asleep, through the influence of their spirit.

This also, I think, cannot be pronounced *a priori* impossible, though the difficulty is the same as before.

(*c*) There is what Kant calls the "formally" supernatural, where qualities, properties, or forces remaining unchanged, the method, connection or intelligible bearing, and consequent result, of existing forces, are different from what the laws of material nature, by themselves, would produce. Here, of course, we are carried back to the first and second hypothesis concerning marvelous events, sc., that they are the effects of the action of man's spirit, or some other spirit, upon the phenomenal world. But here we view the free spirit operating upon nature (which is not free), as from without and from above. It may be the finite spirit making use of powers supplied by the infinite one, as when the free will of man introduces supernatural results into nature by freely combining agents, bringing forces into special application and producing intelligible results. We are so familiar with these that we do not ordinarily call them supernatural, since in common application the word may mean almost anything that is extremely unfamiliar and wonderful; and yet these results may be widely different from anything which nature itself would have produced. Such are, the mule among beasts, the gardener's flowers, the diverted water-courses, the rough made smooth, the crooked straight, the high places laid low, and rock and swamp made to bloom like Dante's terrestrial Paradise.

If, then, any one find it not unscientific or unphilosophic to recognize a conscious being of infinite wisdom, it will not be unscien-

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[1] The present (1880) Archbishop of Dublin.

tific or unphilosophic to assume the possibility of his doing, on a limitless scale, what we do on the smallest, without altering, any more than we do, one law, force, property, or attribute which, on that theory, has been his own perpetual working from the beginning of the world.

(4) Lastly, the supernatural, as a notion of our minds, might mean that which I, for my part, would be inclined to regard as a purely negative notion, and no positive thought at all, viz. : what follows no law of material nature, but is an immediate operation of a supreme being, without material antecedents or any medium whatsoever. This is what Spinoza discussed as an interruption of the order of nature, and tried to show to be impossible.

Returning to the formally supernatural, I may observe that it finds its rational harmony and unity with the natural; first, because, as stated, the forces, attributes or properties of things remain unchanged; secondly, because the adaptations, ends and moral relations of things are similar. I mean that man, by his free spirit, does similar things to what nature does. Whether this remark apply to neo-platonist wonders of old, and spiritualist wonders of recent days, I will not inquire. But I remember that one who, as Sir William Hamilton says, would have been the greatest of philosophers had he not been greatest in another sphere, notices that the historical wonders recorded in the christian sacred books are strictly analogous to those which are always produced.[1] And this remark will illustrate my meaning to any one who admits adaptations, ends, and moral relations as existing in the present order of nature.

Consider, e. g., an earthquake or the Chicago fire. The phenomenal sequence can be investigated according to known laws. It proves to be a chain of a number of links practically infinite. The intelligible or moral end, if such exist, does not come under the province of phenomenal induction. If it exist, it may be sought for, but by the aid of suitable principles, not by scientific induction.

A man may know in himself, in his own conscious life, moral

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[1] S. Aug. de Trin, III. 5.

results from a fire or from illness. He may discover these in the history of a community, as he does again when that community, accumulating wealth, becomes dissolute and luxurious, which is a moral consequence from physical antecedents (not necessary, like physical sequences); or, by war, is reduced to poverty, with certain other moral results.

When we look merely at the scientific sequence of phenomena these results may be said to be accidental, or contingent, but there they are, and the explanation of them involves the prior question whether, as some of the ancient philosophers agreed, there is an intelligent providence in nature, adapting physical consequents to moral results.

Our search for a definition of the supernatural has landed us in the *providential*, which latter is surely an admissible scientific hypothesis. And what does the supernatural add? Or is the providential itself supernatural, as something *superadded*, upon nature, and *vice versa*, except that a certain element of unusualness is added? The answer must be deferred. But let us observe that if the providential is not in nature, *cadit quæstio.* If it be present, we may call all this moral adaptation supernatural, as not directly implied in the physical laws, nor capable of reduction under them.

III.

Proceeding now to the proof of my main proposition. I rest it on the following principles:

(1) *Appearances or events*, no matter what they may be, common or most rare and strange, *may have various antecedents, known or unknown.* Science proceeds with sure steps from antecedent to consequent. For each cause has some certain invariable effects. But it is otherwise in going back from observed results. We must assume physical antecedents, or rather, combinations of them, we are never absolutely certain what they are. Various causes, infinite combinations of them, may produce a given effect. For example, the so-called "diluvial scratches" are now referred to the action of glaciers. An antecedent is found to have existed, a sufficient one, but a different one from what was assigned only

a few years ago. It is adopted as a working hypothesis, and it answers every purpose; but it is liable to be replaced by other antecedents, as it has itself replaced the theory of deluges. The raising of a body in the air, or its resting on the surface of water may be due, not to a suspension of the law of gravitation, or to a change in the specific gravity of elements, but to the unknown attractive or repulsive force called magnetism, to other unknown forces, or even, conceivably and within the potentialities of matter, to the influence of a spiritual substance on that body, which latter would not be, any more than the former, a suspension of nature's law, or an interference in nature's sequences, which might go on as usual. The attested fact must be tested as others are, by the rules of testimony; it must not on *a priori* grounds, at least, be rejected. Experience informs us of the frequent fact of spirit influencing matter, while the same experience points to an unbroken chain of physical antecedents. What, then, may not a more powerful spirit, if it exists, effect upon that purely potential and passive thing called matter? What unimagined and unimaginable powers, lying dormant in it, may not be awaked by the energetic touch of vivifying spirit?

All this may be called wilful fancy, not based on experience, and not *verifiable* by repeated experiment. To which I reply, that the asserted event is itself a fact of experience narrated by witnesses, while the verification, the repetition of it, supposes that we are able, (1) to *explain* the event by giving all the antecedents, and so (2) to reproduce or find them, which is precisely what we may be unable to do. In this case we may not know by observation, but will certainly have no warrant for rejecting the observation of other men. In fact we are obliged, in thousands of cases, to rest contented with the observations of other men, and may have no hesitation in doing so, even if only one man has observed the fact, and we think we can trust him.[1]

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[1] I know a scientist of many years' experience, who tried to verify certain reported observations on "vortex-rings," and saw hundreds of experiments give a different result. He did not dispute the asserted fact, but, I suppose, assumed, rather, that the antecedents in his experiments were different and produced a different result.

The verifications now before us do not, indeed, suppose a costly apparatus, excessively difficult experiments, with results requiring most delicate powers of observation. Or if the question lay between different hypotheses in accounting for the same fact, examination by scientific experts might be deemed a *sine qua non.* But the facts submitted to us by testimony are simply observations of our senses in which all men are equal; while on the other hand the fact that free spirit is concerned, and moral conditions therefore requisite, may make the coincidence of antecedents excessively rare, while yet the results, when they do occur, will be patent to every man of common sense who has the eyes and ears that belong to the whole human race. Repeated failures of "spiritualists," therefore, cannot negative any well-attested observation, if it be justly deemed above suspicion.

(2) In the second place, *inductive science ascends along a chain of physical antecedents which is, practically, of an infinite number of links, and which has no place for mind anywhere in the series.* Its end is never reached, possibly, never can be reached; if, indeed, it should not eventually be found to be a circular chain, which consequently has no end at all.

But mind, if you grant its existence, is known to modify results, without entering as one link in this chain. The very freedom of mind renders it impossible that it should so enter. *How* this can be no one, I believe, has thus far explained. The fact is one of observation. You may, observing my body as an object external to yourself, see the motion of my finger, and then proceed inductively to contraction of the muscles which you cannot see, to nerve-power, brain stimulus, nutrition of brain, blood, chyle, bread and beef, grass and carbonic acid,— equal energy in all these — and you may end no one knows where. You cannot insert mind anywhere in that chain, nor find physical force augmented or diminished by it. You cannot know what I know in my own consciousness, that I freely willed to move my finger. If there is no such thing as free mind, *cadit quæstio* once more; but it was my postulate.

I am not concerned with the explanation of the apparent paradox, nor with the question which Kant asks and thinks that he answers, "whether an effect determined according to nature's laws can at the same time be produced by a free agent?" But there is the fact, mind modifies the force or energy in bread and beef for a new and sensible result. Similar modifications, therefore, are possible elsewhere.

I will take another example, and one which will illustrate other propositions of mine beside the one immediately before us. A man receives a letter or reads an article in the newspaper, and then sends a bullet into the breast of the man who wrote the words. Physical science calculates the force of the bullet, of the powder, of the spring of the pistol, of the finger, of the brain, as we may suppose, and so on. But the *reading of that letter* was an act of mind; and mind supplied the motive for the act, but the motive adds nothing whatever to the physical force. There is nothing in mind which can be inserted into the chain of physical antecedents. Motives, like moral results, belong to another science, having its own laws, which do not interfere at all with those of natural science, although physical results are modified in the most remarkable manner.

(3) Thirdly, my argument compels me to note that the narrators of the marvels to which I have referred have no occasion to offer any theory concerning these results, or, if they do offer one, we are not concerned with that in our question of the *a priori* credibility of the facts. Mr. Crooke's mode of accounting for "spiritual" phenomena is quite another matter. One narrative puts the subject on its proper footing where a man says, "One thing I know, that whereas I was blind, now I see." The only theory, so far as I know, which the narrators offer in the Christian sacred books, is that of the moral end and bearing of the events which they describe, or what we find also in much Greek philosophy, and may call the *providential* character of the events, which, of course, would not essentially distinguish them from ordinary occurrences. But with this, science, as such, has nothing to do.

I have only occasion to refer to it as illustrating my proposition that witnesses of wonderful events can only give us their sensible impressions. For example, dwelling on this providential character of events, going back, therefore, to the first cause, and leaving out of view all physical antecedents because the writer was not interested in them, one says that a free spirit sends the rain, and makes the wind blow; but, on special occasions, a man is said to have prayed and the rain came; and the east wind is said to have driven back the waters of the sea at the head of the gulf, so that fugitives might pass. What preceded in the chain of physical sequences the narrator does not pretend to say, because he is not a scientist. If we infer that he meant that there were no antecedents, and so dispute his narrative on *a priori* grounds, we are putting our own inferences into what he says. Some people have regarded nature as a machine moving on of itself, and, occasionally, not doing all that it ought; whereupon the maker of it steps in and adjusts it for a special work. And while this seems to be irrational, we read historical statements by the light of this pretended explanation, and judge them accordingly. There is not the slightest evidence that the observers of the events had their vision clouded by any such hypothesis, as a man might go to see what some scientists have described as "spiritual manifestations," with his mind made up in advance, and, consequently be not a clear-headed and clear-sighted observer of what was under his nose.

In a simpler age, without any scientific theory, the historian may relate both familiar and strange events with the same direct reference to the primary, efficient and final cause, and none at all to physical antecedents. The antecedents of the Chicago fire are known; its moral bearings, if it have any, are matters of inference and analogy. But the antecedents of the destruction of the fertile plains on the lower Jordan where the Dead Sea now lies one thousand, three hundred feet below the Mediterranean, are not known, and the ancient narrator, whoever he was, takes the liveliest interest in its moral bearings. But, if his narrative be otherwise credible, we are not obliged to assume that he said that physical antecedents were not in their place, and so reject his story on that account.

IV.

But it may be said that these are *natural* events, while others which are narrated in the same manner are *unnatural* and therefore impossible. Such, *e. g.*, it may be said, are some of the "spiritualist" wonders, or the "miracles" at Knock, in Ireland, or, again, the story that the touch of a man's hand, or even his shadow, cured the sick. Here, it may be said, is no "natural" connection of antecedent and consequent. But it would be well to define precisely what we mean by "unnatural." (1) It cannot very well mean what is incapable of explanation. For no one explains how quinine cures malarial fever; yet one does not, on that account, call the cure unnatural. (2) It cannot mean an effect which is without any physical antecedent, for physical antecedents, such as a shadow or a touch, may chance to have been observed in very marvelous cases, like those just referred to. (3) It ought not to mean a violation of nature's laws, for that would be begging the question which is the very subject of our discussion. "Unnatural," therefore, can only mean very unfamiliar, and that the particular antecedent mentioned, if we see it repeated *under other circumstances*, is not followed by the same effect. A most unscientific mode of thought, even if the best of scientists fall into it. A scientific treatise, indeed, ought to give all the antecedents; an unscientific observer mentions only what he happens to see, though his narrative may imply many other antecedents, as the ordinary stories of spiritualists, and those which I have just referred to actually do imply. I suppose that shadows are not ordinarily followed by marvelous cures; and so, without any reference to scientific principles, there is an inward persuasion that there was no connection between the antecedent and the consequent, and the alleged event is pronounced "unnatural," or else the attempt is made to refer it to some known law, as if the measure of our knowledge were the measure of all existing laws. But let an impartial inquirer supply, if he can, all the antecedents, not only physical, but moral and spiritual, before he decides that such a narrative is *a priori* impossible.

And he ought not to object to the introduction of moral and spiritual elements as modifying the physical chain to which they do not belong, since he probably knows consequents from bread pills and Dr. Beddoes' cure of paralysis by a thermometer placed under the tongue, and, conversely, that the state of the soul will arrest the process of physical antecedent to physical consequent, so that medicine fails, as we say, to have its usual effect. And yet it would seem improper to call this unnatural, or a violation of nature's laws.

The arresting of processes of dissolution and of the passage of elements into new forms, followed by the rising again of the dead, would be a most startling occurrence. We cannot easily, if at all, imagine its antecedent. But the appearance of a new, intelligent being in the physical universe (if my sixth postulate be granted), is equally so. But we do not speak of a suspension of laws or an "*interposition*" of the first cause in this case. There are known physical antecedents so far and so far only as the new-born child belongs to the physical universe. But no explanation of the sequence which results in an intelligent human being can be given. In the other case also, if well attested, will be physical circumstances excessively rare; conditions which put verification out of the question. The fact, if received, is to be received on other grounds than those of physical science; but the latter has no valid objection to present. I might bring forward an analogy, of course, a feeble one, but a supposable case. Let us suppose the galvanic current applied to a nerve still sensitive, in a body which has lost its general life. A new combination of physical antecedents produces a result which is entirely new and startling. But the order of nature is not suspended, although only a few persons can verify the fact by renewing the same conditions. So also it is at least *conceivable* (and that is all that I require) that a spiritual power, granting its existence (my sixth postulate), should preserve that sensitiveness in a body called dead, and subsequently restore to it its soul. The latter is a substance known only by its recognizable phenomena, by its operations in, on and through the bodily organs. The body then will resume its normal functions. The man will live again. There I fail to see any suspension of nature's physical chain of sequences. Science, then, must relegate the fact, if a dead man is revived, to what Bacon calls "instantiæ monodicæ, "or "heteroclitæ," or "irregulares;" not that they obey no rule, belong to no species, but, for the present, they stand alone.

In fact, this perhaps will be one of the fruits of startling discoveries in science, that our limited notions of the potentialities of the world will be enlarged. Most grossly improbable as it was, it was hardly received with suspicion by the majority, not very long ago, that a human being could be thrown into a stupor for a century and then revived. "There are more things in heaven and earth than are dreamed of in your philosophy."

As a test and illustration of these principles, I will take, because it happens to be found in a narrative tolerably well known, the assertion that three men were put into a fiery furnace, and not burned. It is a severe test, because we cannot imagine any antecedents, and that which is said to have been there, the intense heat, seems to have had no consequent in the case of these three men; which, by itself, is inconceivable.

But observe that the existence of another spiritual being in sensible form is attested by the writer. Now, as one man works a seeming miracle by substitituting electric currents for waves of sound, so it is certainly conceivable that another freely acting agent should modify or turn back ethereal waves of heat in an unknown manner, secure admission of air, etc., by media absolutely unknown to us, but the order and chain of nature remaining precisely what they are, and, so far as we know, always have been.

Much as the problem transcends our present knowledge, I do not know what is unscientific in the hypothesis, or why, if duly attested, the fact should not be referred to Bacon's "instantiæ monodicæ."

Here I must conclude. I have endeavored to avoid theological questions, and to confine myself to a philosophical and scientific view. This, only, I would ask leave to add, with respect to the presumed controversy between Christian faith and physical sciences, of which so much has been said, that, so far as I know, and I have examined the matter carefully, the positions I have laid down do not essentially differ from those of that great philosopher of the fifth century to whom Sir William Hamilton refers as one of the greatest lights in the world of thought, who did his work so long before physical sciences took their present stand, and who has done more also than any other one man to formulate the faith of western Christendom. For this two-fold reason, I beg leave to refer to him. S. Augustine offers no theory of the "preternatural." The alternatives which he recognizes are, according to nature, and against it. The latter may be our mode of describing such facts as do not seem to follow such laws as we know. But nothing can occur against nature's highest laws, for that would be against the first great Cause. He speaks of daily miracles, i. e., operations of unknown causes, and these are events (e. g., he mentions the wind and rain) which, if unfamiliar, he says, would as certainly be called miracles as any which bear the name, and yet we know that science is busy in tracing their physical antecedents with fair success. S. Augustine accordingly finds the special character of certain events in what he supposes to be the known moral end and bearing of them, not in an "interference," so called, of the worker in and through nature.

Finally, I can only say that it is not my aim to offer my hypothesis as the correct explanation of certain events, among the many marvelous records of history, which are recorded in books held by some of us to be inspired. I have simply taken up a problem of philosophy and science, and endeavored to analyze it in the light of well established principles, and to show that there is no *a priori* ground in science or philosophy for rejecting any such facts. Further than this I do not desire to go.

If I am not mistaken Mr. Huxley has taken some such position. His reasons I do not know.

I will add also, since Mr. Kinnear's paper in the *Contemporary Review* for December, 1879, traverses in part the same ground with mine, that what I have just submitted to the Academy was completed before that number of the *Review* appeared. The fact may increase the probability that the views now presented have some rational foundation, or at least some claim to candid consideration.[1]

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[1] Dr. Bushnell [Nature and Supernatural], indeed, going by a similar route, arrives at the same conclusion; but without defining, he assumes the existence of a personal Being, God, which for the purpose of my argument is not necessary. I have had occasion to examine his work, however, only since this paper was submitted to the Academy.

FIRST FRENCH FOOT-PRINTS BEYOND THE LAKES; OR, WHAT BROUGHT THE FRENCH SO EARLY INTO THE NORTHWEST?

By JAMES D. BUTLER, LL. D.

Copper mines in the north, and burial-barrows everywhere, bespeak prehistoric races in Wisconsin. But in *modern* Wisconsin there was little agricultural settlement before 1836, which we may accordingly reckon its American birth year.

Between these two developments, however, there was a third, a sort of midway station between the mound-builder or the Indian and the Anglo-Saxon — namely, the *French* period. This portion of our annals seems worthy of more attention than it has yet received.

The French were early on Lake Huron, and even in Wisconsin. They were there before the cavaliers in Virginia, the Dutch at Albany, and the Puritans of Boston had pushed inland much more than a day's journey. The Mississippi was mapped before the Ohio. Champlain sailed on Lake Huron in 1615, only seven years after the settlement of Quebec. A monk had arrived there a month or two before Champlain.

On early maps the contrast between French knowledge and English ignorance is at once plain to the eye. On the map drawn by Champlain, in 1632, we see the Lakes which we call Ontario, Huron, Superior and Michigan, while no one of them, nor indeed any river St. Lawrence, is discoverable on Peter Heylin's atlas, the one best known in London twenty years afterward. On the blank, where those inland seas should have figured, we read the words *America Mexicana*, as if Mexico had extended to Hudson's Bay.

But while the English on the Atlantic coast were ignorant of western geography, and before the French in Canada numbered ten thousand, Joliet and Marquette, in 1673, traversed Wisconsin from lake to river. They were long supposed to be among the earliest explorers of Wisconsin. In 1853, however, the Catholic historian, J. G. Shea, pointed out in a volume of Jesuit *Relations* the following words, written from Quebec to France, in 1640, by Father Le Jeune: "M. Nicollet, who has penetrated into the most distant regions, has assured me that if he had pushed on three days longer down a great river which issues from the second lake of the Hurons (evidently meaning Lake Michigan), he would have found the sea."

The word *Mississippi*, meaning "great water," was ambiguous, and, though really denoting a river, might well be mistaken for a sea, especially by an adventurer who knew the sea to be in that direction, and who believed it by no means remote.

On the strength of this Jesuit testimony, Parkman remarks: "As early as 1639, Nicollet ascended the Green Bay of Lake Michigan and crossed to the waters of the Mississippi." This was within nine years after the founding of Boston, which claims to be of all northern cities the most ancient.

But in the lowest deep a lower deep still opens. According to the latest researches of Benjamin Sulte, Nicollet was in Wisconsin four or five years earlier than 1639. He started west from Canada in 1634, and returned the year following. The best Canadian investigators assure us that he never traveled west again, but, marrying and becoming interpreter at Three Rivers, below Montreal, he remained there or thereabouts thenceforward till his death. All agree that Nicollet visited Wisconsin. If it is proved that he was not here in 1639 or afterward, he must have been here before. There is some reason for holding that Nicollet had penetrated into Wisconsin at a date still earlier than 1634.

Chicago is not known to have been visited by any European before 1673. In the autumn of that year Marquette, returning from his voyage down the Mississippi, was conducted from the Illinois river by Indians to that spot as affording the shortest portage to Lake Michigan. The next year that missionary, on a coasting tour along the lake, after a voyage of forty-one days from Green Bay, reached Chicago,— which was then uninhabited. As sickness disabled him from going further, his Indian oarsman built him a hut, and two French traders who already had a post a few leagues inland, ministered to him till the next spring, when he so far recovered as to proceed to St. Joseph. Another Jesuit was also met at Chicago by four score warriors of the Illinois tribe in 1676.

Three years afterward, in 1679, La Salle found no inhabitants there. On his map made the next year he described it as a portage of only a thousand paces, yet thought it in no way suited for communication between the lake and Illinois river, as the latter at low water was for forty leagues not navigable. Within two years after that, however, in 1681, he preferred this route for his own passage. On the sixteenth of December starting from Chicago with canoes on sleds, he arrived at the mouth of the Mississippi in one hundred and seven days,— that is on the sixth of the following April.

The Chicago portage was traversed by Tonty, La Salle's most trusted and trust-worthy lieutenant, June, 1683, and by Durantye in 1685. La Salle's brother detained there in 1688 by a storm, made maple sugar, and in one hundred and ten days after leaving its harbor, had made his way to Montreal.

After eleven years more, St. Cosme found a house of the Jesuits there established, at which, as at a sort of post office, Father Gravier obtained in 1700, letters from Paris. From that point La Salle had written a letter to La Barre, Governor of Canada, in 1683, and in the map by Franquelin, royal hydrographer at Quebec, dated 1684, eighty houses,— meaning wigwams, are set down on the site of Chicago. It was then viewed as a northern out post of La Salle's central castle — the Rock of St. Louis,— that marvellous natural fortress which the French explorer found ready to his hand,— "his wish exactly to his heart's desire," now called *Starved Rock*, near the confluence of the Big Vermilion with the Illinois river, a few miles west of Ottawa.

All the way down from this era of La Salle the French as rovers, traders, settlers, soldiers and missionaries in our Northwest, are traceable generation after generation. The chain is as unbroken as that of apostolical succession has ever been fancied.

How shall we account for the phenomenon I have now sketched, that the French penetrated so far inland so early and so persistently? My answer to this question is implied in the words Fun, Faith, Fur, False Fancies, Finesse and Feudalism.

Nicollet, it is admitted, was west of Lake Michigan before La Salle was born. What brought him thus early into the heart of the continent?

My answer is that he came for sport; yes, just for the fun of the thing — or the romance and exhilaration of adventure.

Where is the community in which it is not proverbial to this day that worlds of fun lie in camping? What amount of civilization can kill off love for a feast of tabernacles, or relish for camp-meetings? What boy reads Robinson Crusoe without a passion to run away? Hunting, fishing, boating, discovering new lakes and streams, new varieties of woodland and opening, attacking or eluding antagonists — whether men or beasts — fire, frost, flood, famine; "foemen worthy of their steel," for what man that is young, strong and brave, must not these excitements have charms? When will the English give up their Alpine club? In France no man was more of a sportsman than the King, Louis XIV, and in his era especially, French country gentlemen spent most of their time hunting and fishing. Accordingly for the French those pursuits had dignified associations. The first French party that ever wintered on the shore of Lake Erie thus wrote home, more than two centuries ago: "We were in a terrestrial paradise. Fish and beaver abounded. We saw more than a hundred roebucks in a single band, and half as many fawns. Bear's meat was more savory than any pork in France. We dried or buccaned the meat of the nine largest. The grapes were as large and sweet as any at home. We even made wine. No lack of prunes, chestnuts and *lotus* fruit all the autumn. None of us were homesick for Montreal." Far west was the happy hunting ground of Indian fable. There too the French found it in fact.

The late Judge Baird of Green Bay used to describe as the happiest three weeks of his life, the time when, taking his family and friends, with a crew of Indian oarsmen, he voyaged in a bark canoe from our great lake to our great river, along the track of Joliet and Marquette. Every day the ladies gathered flowers as fair as Proserpine plucked in the field of Enna, while the men were never without success as fishers and hunters. They camped, usually early in the afternoon, wherever inclination was attracted by natural beauty or romantic appearance. After feasting on venison, fish and wild-fowl, they slept beside plashing waters till roused by morning birds. At every turn in the rivers, new scenery opened upon them. Overhanging groves, oak openings, prairies, rapids, Baraboo bluffs, outcrops of rock, ravines, mouths of branches, each was a pleasant surprise. That merry month of May, 1830, recalled to the voyager, in the long lapse from youth to age, no other like itself. How many would give half their lives for such a wild-wood memory!

In the light of such an experience, it is easy to see how Nicollet was drawn on and on into the unknown west. No wonder that, only ten years after Quebec was occupied, we find him, in 1618, wintering half-way from that new-born post to Lake Huron, in the Isle of Allumette. He had no longing for the security of dwellers beneath the guns of Quebec. Amid his perils he despised them, as Caudle-lectured husbands despise those couples who vegetate together for years without a cross word, but in such a stupid style that they never know they are born.

Nicollet was a representative of a *large element* among French Canadians. In 1609, at one of Champlain's first interviews with Indians from the remote interior, a young man of his company had boldly volunteered to join them on their homeward journey, and to winter among them. He remembered Pierre Gambie, a page of Laudonniere in Florida, who being allowed to go freely among the Indians, had become prime favorite with the chief of the island of Edelano, married his daughter, and in his absence reigned in his stead. Champlain's retainer was among the first of a class — up to everything, down to everything — who "followed the Indians in their roamings, grew familiar with their language, allied themselves with their women, became oracles in the camp and leaders on the war-path."

Their fun was as fast and furious as Tam O'Shanter's:

> "Kings may be great, but they were glorious,
> O'er all the ills of life victorious."

For them civilization was no longer either cold or hot — but so lukewarm that they spewed it out of their mouths. Something of their feeling burned in their best historian, Francis Parkman, who exchanged Boston for the Black Hills before one miner had pushed into their fastnesses. His strongest youthful passion was to share in unaltered Indian life, and his loudest cry was: "Savagery, with all thy lacks I love thee still!"

Preference for Indian life has grown up even in *Yankee* captives, and, what is most surprising, in *females*.

A well-known instance was the daughter of Williams — the Massachusetts minister — who refused to be redeemed from captivity in a Canadian tribe. Some will suggest that having been brought up in a parsonage of grim and vinegar aspect, she thought nothing could be more repulsive than a Puritan strait-jacket. But many similar instances occurred during Bouquet's expedition west of the Ohio, which was undertaken in order to rescue whites from Indian bondage. Several women, and those not of ministerial families at all, when compelled to return to white settlements, soon made their escape to the woods, preferring wigwams to their native homes. No thrice-driven bed of down was so soft to them as a couch which, as their phrase was, had never been made up since the creation. Many captive *men*, when given up to Bouquet, and bound fast to prevent their escape, sat sullen and scowling that they were forced back into society.

In civilized society there was no sweet savor of romance for

> "A wild and wanton herd,
> Or race of youthful and unhandled colts."

No wonder, then, adventurers into the great west, who would rather be scalped at Mackinaw than live in Montreal, became a permanent class. No wonder when La Salle, first of white men, had burst into the heart of Illinois, six of his soldiers deserted, and that as many more of his little band had ran away in the far north. One of these last absconders was encountered by Hennepin in the wilds of Minnesota. Another in that region was a runaway from Hennepin himself. Nothing less than throwing themselves overboard from all social restraints could give scope for that superabundant vitality which philosophers hold is preeminently a French characteristic.

The roving class was all the larger, because settled colonists were *vassals*, both in soul and body. In Canada, individuals existed for the government, not the government for individuals.

Cooped up in the dull exile of petty forts, their prayer was that of the country mouse when entrapped in a city mansion —

> " O give me but a hollow tree,
> A crust of bread and liberty."

La Hontan — a young officer fresh from France — thus wrote home from Montreal : " A part of the winter I was hunting with the Algonquins, the rest of it I spent here very disagreeably. One can neither go on a pleasure party, nor play cards, nor visit the ladies, without the curé preaching about it; and masqueraders he excommunicates."

Other writers add that no dances were allowed in which both sexes took part.

Allowing dances to one sex only was about as satisfactory to gay and festive youth as a father confessor's permitting a fair penitent to rouge only one side of her face; or letting out an American lady to walk the Parisian boulevards only on condition that she never goes alone, never wears colors, and never looks into a shop window. Anti-dancing laws — it is needless to add,— were doubly vexatious to a Frenchman, since his feet when he's sleeping seem dreaming a dance.

Fathers who neglected to marry sons till they were twenty, or daughters till they were sixteen, were fined. Bachelors were barred out from the Indian trade, and even branded with marks of infamy.

In Quebec chronicles for 1671 we read that Paul Dupuy, having said that when the English cut off the head of Charles I. they did a good thing, the council declared him guilty of words tending to sedition, and condemned him to be led in his shirt, with a rope about his neck and a torch in his hand, from prison to the castle, there to ask pardon of the king; to be branded on the cheek, set in stocks, laid in irons, etc.

At the same period Louis Gaboury, charged with eating meat in Lent, was sentenced to be tied three hours to a stake, and then on his knees to ask pardon at the door of the chapel. Swearers, for the sixth offense, had the upper lip cut with a hot iron, and if they still uttered oaths, had the tongue cut out altogether. Two men were shot at Quebec for selling brandy to Indians.

Not a few French immigrants had been *tramps* in the old world, and transportation to the new world gave them no new nature. The Bohemian element was in them as an instinct, and was as sure to come out by natural selection as ducklings hatched by a hen are to take to water. The Saint Lawrence flowed in one direction; the sinful loafers steered in quite another.

Other Canadians had been *convicts* and so would naturally regard all walls as stifling imprisonment. They were not a pious race, but one prayer they never forgot, namely: "From red-tape and ritualism, good Lord, deliver us!"

An order of Indian Knights sprung up — young men who thought nothing so fine as to go tricked out like Indians, and nothing so attractive as Indian life; doing nothing, caring for nothing, following every inclination, and getting out of the way of all correction. This club may have been a natural reaction from a society of matrons and maidens established to promote gossip pure and simple. Meetings were held every Thursday at which each member was bound by a gospel oath to confess — not his own sins, but other people's — that is, all she knew, alike good and bad, regarding her acquaintance.

There is a *physical* reason why those who have learned to live in the open air cannot live in houses. Sleeping under roofs they exchange oxygen for miasma.

The Circassian mountain chief, Schamyl, when a Russian prisoner, was luxuriously housed, but at the end of a week told his keepers he must commit suicide unless they would allow him to lodge *above* the roof instead of under it. So, too, our Texan hero, Sam Houston, when, after open air campaigns, he entered the hall of congress, compared himself to a mouse under an air pump.

"Yes, there is sweetness in the prairie air,
And life that bloated ease can never hope to share."

During several years of frontier life, I have constantly fallen in with frontier men, who hover in the wilderness beyond the utmost verge of settlement. Villages, or at least ranchmen, follow them but only, as Paddy prays the blessing of the Lord may follow his enemies all the days of their lives — that is, so as never to *overtake* them at all. Change of base and new departures are as familiar to them as to any politician. The only grain they ever sow is *wild oats.*

The French found more fun in woodcraft than the *English* could. The one could thrive where the other would starve. It is an old saying that a French cook will make more out of the *shadow* of a chicken than an English one can of its substance. When a French army, near Salamanca, was cut off from supplies for a week by Wellington, he thought it a miracle that they did not surrender. The truth was that they had subsisted all the while on acorns. For more than a week Nicollet's only food was bark, seasoned with bits of the moss which the Canadians named *rock-tripe.* But he was not starved out. The Roman empire spread widely east and west, but never very far north. The fact is strange. To account for it, some say that Roman noses were too long, and so were nipped off by Jack Frost. The French are a snub-nosed race and so could better brave blizzards.

There is a strange *elation* when we discover with how many so-called necessaries we can dispense, and while having nothing, yet possess all things which we absolutely need. Detecting new capabilities, whether of daring doing or enduring, we seem to become new beings and of a higher order. We discover new Americas within ourselves.

According to the Greek sage, he is nearest the Gods who has fewest wants. In proportion, then, as we become self-sufficing, we approximate to the Gods. Not without exultation did the adventurer learn to make all things of bark — not only baskets, dishes, boats and beds, but houses and food. Every *tree,* when he perceived its bark to be rougher and thicker on the north side,— became for him a compass-plant. In his whole manner of life "the forester gained," says Parkman, "a self-sustaining energy, as well as powers of action and perception before unthought of,—

a subtlety of sense more akin to the instinct of brutes than to human reason. He could approach like a fox, attack like a lion, vanish like a bird."

The Homeric and earliest ideal of an adventurer, single-handed, into unknown regions, was Ulysses. It is true he goes grumbling all through the Odyssey,— but for all that he is happier to the very core than he could be with Circe or Calypso in any castle of Indolence. He thrives under evil, and at every new stage of his wanderings has new greatness thrust upon him. More than this: According to Dante, who met him in the Inferno, he soon tired of the Ithacan home he had sought so earnestly, and quitted it for enterprises more distant and perilous than ever.

Many of the early French pushed westward in pilgrimages longer and more varied than that of the most wide-wandering Greek. Their motto was:

> "No pent-up citadel contracts our powers,
> But the whole boundless continent is ours."

They pushed into the heart of the continent faster and farther, thanks to matchless highways,— I mean rivers and lakes,— styled by their wisest contemporary, Pascal, "roads which *march* and carry us whithersoever we wish to go." Thanks also to bark canoes, they flew as on the wings of eagles into the recesses of the west. When wishing to traverse Indian routes they had sense enough to avail themselves of Indian *boats*, doing in Rome as Romans do. For nine dollars worth of goods the voyageurs bought a bark twenty feet by two that would last six years. It would carry four men and more than their weight in baggage, yet was not too heavy for *one* man to carry across the portage between river and river, or round rapids which no boat could climb. Hennepin's bark weighed only fifty pounds. At night or in rains it was a better shelter than a tent. Thus the boatman was as independent as a soldier would be who could carry on his shoulders not only his horse and baggage, but also his barracks. Previous to the year 1673, no boat of *wood* had ever ascended above Montreal. The bark canoe of Judge Baird, of which I have spoken, was on a larger scale — about thirty feet long and five broad. It carried thirteen people and all their needments with ease.

Year after year La Salle risked life and lost fortune laboring to build a forty ton vessel for descending the Mississippi. After heart-breaking failures he trusted himself to a native canoe, and thanks to this new departure, easily gained the goal of his ambition. Had he found the great river hedged up by Niagaras — as was reported by natives — his progress would not have been stopped. He could have carried his boat till his boat could carry him.

A man who riding for the first time in a cab and asked where he was going answered, "To Glory!" spoke out the exultation which thrilled every French adventurer with his face set toward the western unknown, his hands skilled in paddling a bark canoe and himself encumbered with no more baggage than the shipwrecked rascal who said he had lost everything except his character.

Throughout the orient the name of *doctor* is a sesame open. When Moslems overhear a traveler addressed as doctor they unbar for him even their harems, no matter how often he tells them that it is only in law or divinity or farriery, that he is a doctor.

Among savages everywhere every civilized man passes in spite of himself for a physician. Relying on this reputation the early French ventured into the infinite west. Nor was their quackery less successful than that of an English monarch touching for the king's evil when

> "Strangely visited people
> All swollen and ulcerous, pitiful to the eye,
> The mere despair of surgery, he cures."

When Hennepin was a captive among the Sioux, whose blood had before been drawn only by the sucking mouths of medicine men, he bled their asthmatics, he treated other patients with a confection of hyacinth (a sort of squills) and desperate cases with *orvietum*, a theriac compounded of three score and four drugs. The more ingredients the more certain, as men thought, the cure, as the more bullets in a volley the more surely some of them will hit. A decade earlier, Perrot having dosed a surfeited glutton with the same theriac, had succeeded as well as the druggist, who, when *vox populi* was prescribed, gave *nux vomica.* The next night Perrot was waked by chiefs who came for more theriac. His supply was so small that he only allowed them to hold their noses over the vial. The odor, however, proved a panacea. They beat their breasts and declared that it had made them immortal. For this sanitary smell they insisted on paying Perrot ten beaver-skins. They believed, what no doctor has been able to beat into Christian patients, that no medicine could do any good if it was not paid for.

These patients were Miamis. The Sauks, on the other hand, thought no medicine efficacious unless it was bestowed without money and without price. One of their tribe who had been badly scalded, declared himself cured the moment he was presented with a gratuitous plug of tobacco.

Relish for the romantic was a considerable element even in *missionary* zeal. Thus Hennepin admits that a passion for travel and a burning desire to visit strange lands had no small part in his own inclination for missions.

Again, many early bush-rangers belonged to that class who would rather reign in hell than serve in heaven. La Salle fell in with one tribe in mourning for the death of a chief, and he said: "Dry your tears! I will raise him from the dead. Whatever he was to wife, children or tribe, that I will be, feeding them and fighting for them. He is dead no longer." Thereupon he was hailed as chief.

Still others dashed among distant cannibals, in hopes, like Brigham Young among Mormons, to become Gods on earth. It paid for all privations to hear cringing Calibans cry out: "We pray thee be our God! We'll fish for thee; we'll kiss thy foot."

Saint Castine, who had nothing saintly but the name, roaming with Indians not far from the seaport in Maine which keeps his name in memory, gained such a supremacy that his aboriginal associates deemed him the prince of the power of the air.

In 1683, Perrot having built a fort near the outlet of Lake Pepin, paid a visit to the Sioux up the great river. He was placed by them on their car of state, which was a buffalo robe. He was thus lifted on high by a score of warriors, not like Sancho Panza tossed in a blanket, but borne as reverentially as the Pope on his *sedia gestatoria*, or portable throne, into the house of council. There, holding a bowl of brandy which the Indians thought to be water, he set it on fire. He thus made them believe that he could at will burn up their lakes and rivers. A score of years before,—certainly as early as 1665,—he had become a potentate among Pottawatomies near Green Bay. Perrot was worshipped with clouds of incense from a hundred calumets, because he brought iron,—especially in the shape of guns and tomahawks. The further west he went the more unheard of his iron and powder, and the more they proved him a God.

One mode of reverence was to break off branches of trees and sweep the path his feet were about to tread. But the divine honors paid to Perrot were not always delightful. The Iowas, whom he pronounces the greatest weepers in the world, wept most effusively at his coming. Their welcome, he tells us, was bathing his face with their tears—"the effusions of their eyes, and alas! of their mouths and noses too!"

Other French adventurers threw up *rockets*, and thus record the sensation: "When the Indians saw the fireworks in the air and the stars fall from heaven, the women and children began to fly, and the most courageous of the men to cry for mercy and implore us very earnestly to stop the play of that wonderful medicine. Had there been any accidental explosion of chemicals so that one of the braves was blown up, he would have deemed it all a part of the show, and as soon as he caught breath would have exclaimed: 'What next? What in the world will these magicians do next?'"

The simplest French conveniences were sublime in aboriginal eyes. The Mascoutins, when Perrot appeared among them, knew no mode of producing fire except by rubbing two sticks together. Such friction was ineffectual whenever the sticks were at all wet, and they were often too damp to kindle—an Irishman would say—till one had made a fire and dried them. Naturally, Perrot's tinder-box was venerated as an angel from heaven. No wonder that a hundred dozen of these Promethean fire-bringers are set down in the outfit of La Salle. One of an antique pattern, lately discovered in an Illinois cave, was shown me in

Ottawa. Possibly it is one of the twelve hundred imported by La Salle. Had lucifers been known to the French, starting camp-fires in a twinkling, they must have converted every Indian into a fire-worshipper and conquered the continent.

The Indians wished that their children should grow up bald, aside from scalp-locks. Their style of hair-cutting had been to burn childish scalps with red hot stones. Hennepin's razor, though none of the keenest, was clearly a better depilatory, and so was hailed as a miracle of mercy.

Nicollet met in council four thousand Wisconsin warriors, who feasted on six score of beaver. He appeared before them in a many-colored robe of state, adorned with flowers and birds. Approaching with a pistol in each hand, he fired both at once. The natives hence named him "thunder-bearer." Such a spectacular display was in keeping with the policy which marked the old French regime in two worlds, and which for centuries proved equally sovereign in both. The apotheosis of Nicollet would have been complete if he could have carried a Colt revolver — the thunderbolt of Jove in the thimble of Minerva, omnipotent as ever, yet so small that Cupid would steal it, as no longer too heavy for him to lift or too hot for him to handle.

Of all Europeans the French only gained the *affections* of natives. From the beginning they fraternized with them as the British never could.

They never sold Indian captives for slaves on southern plantations as the English did. Through hatred of New Englanders fifty families of Indians there flying west became retainers of La Salle, and some of them were his most trusty oarsmen and braves in discovering the Mississippi. Four score years, said La Salle, have we had Indian allies. Never has one of them proved false to France. We can safely trust them with arms. From first to last the Illinois tribes were faithful to the French. When the French, after their loss of Illinois, went west of the Mississippi in 1763, the Indians followed them. Each tribe loved the French with an affection so ardent as to be jealous, and strove to keep them all to itself, resenting their dealing with any other tribe as a sort of adulterous infidelity. For a score of years Nicholas

Perrot won golden opinions among the Outagamies. After his departure they declared in council with the governor of Canada, that their fathers having gone they had no more any breath, or soul.

The French captivated the Indians and the Indians captivated them. For them, then, there was a fullness of fun — yes paradise where John Bull would have felt himself in such a purgatory that he could not fare worse by going farther.

One Englishman who had been forced to make trial of savage life, when asked how he liked it, answered: "The more I see Indians, the better I love dogs." But amid the same horrors a Frenchman enjoyed himself so well that he declares he was ready to burn his cook books! What could Frenchman do more?

In no long time most northwestern tribes were tinctured with French blood. Perrot treats of French among fugitive Sauteurs on the south shore of Lake Superior as early as 1661. The first permanent settler in Wisconsin, Charles Langlade, was a French half-breed. So was the first squatter at Madison — (long before the Peck family), St. Cyr, the only saint we could ever boast. In 1816, when the United States forces took possession of Wisconsin, the natives being assembled for treaties, said: "Pray do not disturb our French *brothers.*

Adventurers among western aborigines in time became fur-traders or interpreters and factors for such traders, as well as missionaries or other officials both military and civil. But their *first* impulse to plunge into the depth of the wilderness, and to abide there, was because they liked it. To their imaginations forest-life was as charming as the grand tour of Europe a generation ago to ours, or as is girdling the terraqueous globe at the present day, or as roughing it on the Yellowstone to General Sherman, or on the great divide to Lord Dufferin, or rounding the world on horseback to Sir George Simpson, or Beltrami's solitary scamper to the sources of the Mississippi, or the three years cruise of the Challenger to Lord Campbell, whose Log Letters skimming off the cream of all climes and finding no drop sour, cry out in every line, "O what Fun!" It was much more than all this, and can only be compared to the wild dedication of himself to unpathed waters, undreamed shores and sands and miseries enough by Stanley, in quest of Livingston, or the sources of the Nile and Congo.

Seekers of pleasure in the pathless woods followed Nicollet into *Wisconsin*, as well as elsewhere in the Mississippi Valley. Their race endured, and it still endures. Some survivals of it were met with in the first decade of our century far up the Missouri, by Lewis and Clark, and by Pike at the sources of the Mississippi. Within the last ten years, the British Major Butler, with whom I traveled down the Red River of the North in 1872, encountered them on his pilgrimages throughout the great lone land and the wild north land to the shores of the Pacific.

Enamoured of wild sports, the French more than two centuries ago rushed from Lower Canada into the borders of the Upper Lakes. They came the sooner thanks to unrivaled facilities for boating, hunting and fishing,— to an appetite for open air which grows by what it feeds on,— to their feeling at home in wigwams, to their passion to break loose from law martial and monkish, and to enjoy unbounded license, as well as to the pre-eminence which knowledge gave them among barbarians. To the love of fun, then, and the full feast of it fresh as the woods and waters that inspired it,— with which he could fill himself in western wilds, we in Wisconsin owe the explorations of Nicollet and others of like temper, and so our most ancient historic land marks. One of the first French foundations here was laid in fun. Fun then was *fun*damental.

But if fun led the way to exploring the far West, *faith* also was there, and not least in Wisconsin, a French foundation.

Faith followed hard after fun, and sometimes outstripped it. The friar, Le Caron, was on Lake Huron before Nicollet had penetrated half way there. Nicollet lingered in the Isle of Allumette, several hundred miles short of Lake Huron, till 1620. But, five years earlier, mass had been already said on that lake by the Franciscan with sandaled feet and girt with his knotted cord. The monk's passage had been paid by the governor, but he worked his own passage and that bare-footed, since shoes would injure the bark canoe. He thus wrote to his superior: "It would be hard to tell you how tired I was with paddling all day among the Indians, wading the rapids a hundred times and more, through mud and over sharp stones that cut my feet, carrying the canoe and luggage through the woods to avoid cataracts, and half starved the while, for we had nothing to eat but porridge, of water and pounded maize, of which they gave me a very small allowance." Through the winter of 1615 in a hermitage a thousand miles west of Quebec which was itself an ultima Thule,— this friar was making catechisms or struggling with the difficulties of the Huron tongue, or expounding the faith in broken Indian, and by way of object lesson showing "four great likenesses of the Madonna suspended on a cord."

As early as 1614, when the French first ascended the Ottawa, they planted crosses of white cedar on its shores and islands. In 1625 the Jesuit Brebeuf began a three years' sojourn on Huron waters. Onward from 1634 a permanent mission was maintained there for fifteen years until the Hurons were scattered to the four winds. Missionaries followed them in their dispersion. In summer plying the paddle all day or toiling through pathless thickets, bending under a canoe or portable chapel heavy as a peddler's pack, veritable colporters, while famine, snow storms, cold, treacherous ice of the lake, smoke and filth were the luxuries of their winter wanderings. We underrate the arduousness of mission journeys until we consider how greatly storms, cold and famine retarded them. Allouer's voyage from Mackinaw to Green Bay consumed thirty-one days. Marquette was ten days more on his passage from Green Bay to Chicago.

Yet, in 1642, Madame de la Peltrie,— a tender and delicate woman,— reared in Parisian refinements, was seized at Quebec with a longing to visit the Hurons, and to preach in person at that most arduous station. In 1641, the year before one house was built in Montreal, Fathers Jogues and Raymbault were distributing rosaries at the mouth of Lake Superior. Previous to 1640 they had become acquainted with Wisconsin Winnebagoes. The earliest Iroquois baptism was in 1669, but thirty years before, scores of Hurons had been baptized hundreds of leagues further west.

The first clear trace of a priest in *Wisconsin* was in 1660. In that year Father Menard, paddling along the south shore of Lake Superior for many a weary week, near its western extremity, reached La Pointe — one of the most northern peninsulas in the region which is now Wisconsin.

"He evangelized the natives who flocked together there." Such are the words of the old chronicler. The meaning is, not that the Jesuit dispensed the whole gospel to the Indians, nor yet all that he could give, but only so much of it, such a homœopathic dose — as they would receive.

Early travelers into the Orient when they there met certain albinos thought them the posterity of blacks converted by St. Thomas and whitened by baptism. It seemed doubtful, however, whether such a skin-bleaching was a real improvement. In like manner, may it be questioned whether the western missionaries who had chosen St. Thomas for their patron were any more successful than he.

However we may speculate on this matter, we must feel that Menard's motives were the best. Sometimes he had no altar but his paddles supported by crotched sticks and covered with his sail. Moreover, he dared not celebrate mass in the presence of those he had there baptized, because it was beyond his power to convince them that that sacrament was not a juggling trick to secure for the priest slaves in the life beyond life. Father Allouez was less scrupulous. He boasts as of some great thing that he had taught one Wisconsin tribe to make the sign of the cross and to daub its figure on their shields. When one of these converts had married three sisters at once and was censured for it by La Salle, his defense was: "I was made a Christian against my will by Father Allouez." In 1672 this father was welcomed by Mascoutins whose head-center seems to have been not far from Portage City.

With Father Menard, in 1660, were three lay-helpers, whom he next year dispatched southward into Wisconsin to certain Hurons who had sought an asylum at the mouth of Green Bay. Having labored nine years for those Hurons in their old home, he soon followed his fugitive converts, but perished in the wilderness of the

Black river. It is believed that he was murdered by the Sioux, for among them his breviary and robe were discovered years afterward. That stream, now called *Bois Brulé*, forms the boundary between Wisconsin and Michigan, and it is not known on which *side* of it Menard lost his life. Both states may, therefore, with equal plausibility, glory in him as their *own* protomartyr. Wading through the sodden snow, under the bare and dripping forests, drenched with rains, braving every variety of unknown horror, faint, yet pursuing to the last, well may we, people of both states, count him worthy of double honor! Doubtless his last regret was that he had not a whole life to lay down for the salvation of each state.

Four years after, in 1665, Father Allouez succeeded Menard at La Pointe, and carried on his work. Very likely, as in the early days of Montreal, his only altar lamp was a vial full of fire flies. When he returned to Quebec for reënforcements, he remained there only two nights before starting back again with volunteer co-workers. La Pointe was then a four months' voyage from Quebec. He was saying mass at Green Bay to six hundred Indians and eight French traders in 1669, and the next year exhibited a picture of the last judgment, at Neenah, on Lake Winnebago. A silver monstrance, the case in which the sacramental wafer is held up for veneration, presented to the chapel of Allouez by the French governor, Nicolas Perrot, and bearing the date of 1686, was dug up, in 1802, at De Pere near the head of Green Bay, and is now treasured in the ambry of the cathedral there. In 1671, a chart (34 × 38 centimeters) was drawn, entitled *Lake Tracy* or *Superior*, with the dependencies of the Mission of the Holy Spirit [that is *La Pointe*]. It is still extant in Parisian archives, at the depot of marine charts. Two years later in the Jesuit relation of 1673, a map of their missions on the Lake of the Illinois [that is Michigan] was published.

In the same year the first white men, one of them a missionary, of whose journey a contemporary record remains, crossed Wisconsin from east to west. These adventurers were Joliet and Marquette — a noble brace of brothers. Equals in enthusiasm, the faith of Marquette, the Jesuit, rivaled the rage for discovery in Joliet, the officer. These explorers were cultivated men, and experienced observers. For five years Marquette had been a western pioneer, partly in Wisconsin, and Joliet, while voyaging on Lake Superior some time before, had also probably trod Wisconsin soil. From Indian reports they had drawn a map of the region they purposed to penetrate, and kept it at hand as they rowed up Fox river, threaded the marshy maze at the grand divide and carrying place — now Portage City — and among herds of elk and deer, floated down the Wisconsin to the great river. Reaching this grand goal on the seventeenth of June, they glided with the current of the Mississippi for a month, and probably to the latitude of Memphis, which, according to their belief, was no more than two degrees north of the Mexican Gulf.

On the return voyage Joliet wintered at Green Bay, where he had found many good Christians the spring before. The next season, when he was about to land at Montreal, his boat capsized and he was only rescued himself after being four hours in the water. His journal was lost — a sad loss for Wisconsin, which was thus bereaved of the wayside notes of the earliest traveler throughout its whole breadth — a record which who would willingly let drown?

After all who knows but Joliet's loss may have turned out for our *gain?* and will still? Who shall count the investigators that, mourning for *Joliet's* misfortune, have thus, or shall, become doubly zealous to gather up and commit to the custody of our Historical Society — or of the art preservative of all arts — every fragment of our annals, letting nothing — no fraction — be lost?

Throughout the last third of the seventeenth century and in all generations since, priests of the Catholic faith may be traced in or near Wisconsin. There Allouez labored for a quarter of a century onward from 1665. In 1677 Frontenac speaks of the Green Bay mission as no new thing. All tribes near that Bay are mentioned in the missionary report for 1658. In 1680 and for seven years thereafter, Enjalran was stationed there. He had been preceded there by Fathers Andre and Albanel, and within a decade was followed by Nouvel, and three others whose names are preserved. As early as 1671 their headquarters were Mackinaw, but they were constantly making excursions and establishing out-stations in the parts beyond. In 1721 Father Chardon had already labored among the Sacs about Green Bay till he had given them up as beyond hope, and was studying Winnebago in order to preach to the tribe of that name. Other missionaries are mentioned at later periods, and the town of De Pere, meaning *Fathers*, is said to derive its name from the fact that two Jesuits suffered martyrdom there in 1765. In the interior of Wisconsin there were also stations among the Kickapoos and Menomonies.

Downward from the expedition of Joliet and Marquette, Wisconsin was the favorite thoroughfare of missionaries as well as others bound for the southwest. Such way-farers shunned the east shore of Lake Michigan as infested by the Iroquois. If they could buy permission of the Foxes they glided down the Wisconsin river as the shortest and easiest route. Those who failed to win Indian favor paddled along the Wisconsin shore of Lake Michigan.

It is a natural question, " *What brought* the Catholic fathers to the farthest west at so early a day, while Protestant missionaries, though abroad in New England before one European dwelt in Montreal, had not penetrated half-way to the Hudson river? "

It might have been predicted from the out-set by a philosophical historian, that French missionaries would out-do all others among our aborigines. They had already showed themselves pre-eminent elsewhere. The French originated the crusades, and from first to last they were the chief crusaders. It was natural for them, changing tactics with the times, to be as zealous against the infidels of the occident as they had approved themselves against those of the orient, and as persistent with litany and mass as they had been with lance and mace. The presence and persistence of Jesuits on our upper lakes and beyond them, more than two centuries ago, is accounted for by one single word — yes, by one syllable, namely *Faith* — their peculiar faith.

The views I now present of Jesuit missions are of course those of a non-Catholic. They must be or they could not be my own, and no one would wish me either to dissimulate my own opinions or to simulate those of others. My information, however, all comes from Catholic witnesses. No others existed then and there.

My account of the French missionaries must be the more one-sided because my present purpose will not let me expatiate upon their tact patience and heroic endurance amid all vexations, culminating in martyrdom. In temptations which we cannot bear to read of, their virtues found a fit emblem in that light from heaven which they came to bring,—sunbeams which, descending to the lowest depths of earth, and however reflected and refracted in abodes of pollution, remain unsullied and continue sunbeams still.

The Jesuits are the Pope's standing army (Loyola's own name for them was a battalion), and the title of their head is general. At the beck of superiors subordinates plunged into the vast unknown of our continent with the unquestioning alacrity of regular troops.

> Not theirs to question why,
> Not theirs to make reply;
> Theirs but to do, or die.

They knew no west or east, no north or south.

But in addition to his vow of obedience, each missionary was impelled by a faith which inspired him with tenfold more zeal and intrepidity. That faith was this: that he bestowed a clear title to heaven on all whom he baptized, unless they lived to commit mortal sins afterward. Hence when one had sprinkled a couple of dying children he writes in his diary: "Two little Indians changed to-day into two angels, by one drop of water. O, my rapture as I saw them expire two hours after baptism." No matter though the sprinkling was effected by pious *fraud*, when Jesuits unable otherwise to approach sick infants, pretended to administer a medicine of sweetened water, but spilled some drops of it on their heated brows, while whispering sacramental words with motionless lips. The little ones were sent to paradise by these waters none the less surely because secretly. Seeing that death quickly followed baptism, Indians soon inferred that it was occasioned by those priestly drops. They were hence prone to scalp a Father if they detected him administering the sacred rite.

We hear with a shock of *burning* prisoners *alive.* But the fathers had little to say against the custom. On the other hand, such an execution seemed to them a means of conversion akin to a Spanish *auto da fe*, and equally efficacious. One of the missionaries wrote home as follows:

" An Iroquois was to be burned some way off. What consolation is it to set forth in the hottest summer to deliver this victim from hell. The father approaches, and instructs him even in the midst of his torments. Forthwith the faith finds a place in his heart. He adores as the author of his life Him whose name he had never heard till the hour of his own death. He receives baptism, and in his place of torture cries: "I am about to die but I go to dwell in heaven." How history repeats itself! In 1877 the last words of Henry Norfolk on the scaffold in Annapolis were: "I am here to hang for the murder of my wife, but I thank God I am going to glory!"

Again, the record is: On the day of the visitation of the Holy Virgin, the chief Aontarisati was taken prisoner by our Indians, instructed by our fathers, baptized, burnt, and ascended to heaven, all on the same day. I doubt not that he thanked the Virgin for his misfortune and the blessing that followed. Happy thought!

Another missionary writes: " We have very rarely indeed seen the burning of an Iroquois without feeling sure that he was on the path to Paradise, and we never knew one of them to be on that path without seeing him burnt." Happy thought.

The conclusion of the whole matter then is: "The only way to save Indians is to burn them," or as they now say in Texas: "Scalp them first, and then preach to them."

Powerful motives then hurried the Jesuits wherever an infant was death-struck, or a captive in torture.

Various *secular* influences speeded the missionaries on their western way.

First, the spirit of religion was reinforced by that passion for romantic adventure which we have just been surveying. Then, according to Father Biard, the French *king*, the most dissolute of men, initiated the Jesuit project. Preachers who were over-zealous he liked to ship off, and so transfer their soul-stinging sermons to the other side of the Atlantic. He thus parried thrusts which might have hit his conscience more effectually, and yet more covertly, than the German duke can whose cathedral pew is hedged about with sliding windows, so that, when he pleases, he can shut out unpalatable doctrines. Again, the French monarch was as liberal in land-grants to Canadian priests as our congress has been to railroads.

Many of his courtiers too, whose idea of Lent was a month when they hired their servants to fast for them, paid roundly for sending so much gospel to the heathen as to leave very little of it for themselves. Others too who would not give a sou of their own money importuned their neighbors till they forced them to contribute, as the fox while sparing his own fur tore skin off the bear's back to make a plaster for the sick lion. Such beggary they thought was a means of grace.

While in lower Canada the Jesuits were to some extent subject to the secular arm, and occasionally were forced to beg the governor's pardon. The powers that were said to them: "Show us the way to heaven, but we will show you yours on the earth." When a Jesuit in a Quebec pulpit declared the King had exceeded his powers by licensing the trade in brandy in spite of the bishop's interdict, the governor, Frontenac, threatened to put him in a place where he would learn to hold his peace.

The same magistrate sent another priest — brother of the author of Telemachus — to France for trial owing to some disrespect, and wrote to the king: "The ecclesiastics want to join to their spiritual authority an absolute power over things temporal. They aim to establish an inquisition worse than that of Spain."

Amid this conflict of authorities the government was glad to transport the missionaries, and they were equally glad to be transported deep into the wilderness; for there all power in heaven and on earth, temporal and spiritual alike, and each doubling the other, was theirs, theirs alone, without rival. Every whisper against them was admitted to be "injurious to the glory of God." They held it better to reign monarchs of all they surveyed among Menomonies than to hold divided empire in Montreal.

When once the Jesuits were planted in the far west they suffered no more from governmental jealousies. On the other hand trade-policy and military power leaned on missions as their main support. Missions were to explore the Mississippi, missions were to win over savage hordes at once to the faith and to France. At a momentous crisis, in 1685, the Jesuit, Engelran, at Mackinaw adroitly kept the lake tribes from defection. The Marquis Du Quesne used to say that Father Picquet was worth ten regiments. One tribe was taught by the Fathers that Christ was a Frenchman murdered by the English, and that the way to gain his favor was to revenge his death. No wonder a chief called out, "O, that I and my braves had caught those English crucifiers. We would have taken off all their scalps."

In those times, when the question arose which we are still vainly essaying to answer, "How was America peopled? how came the Aborigines here?" it was a common saying of theologians that the devil had led the Indians hither that they might be out of the way of the gospel. Accordingly, whoever penetrated into the utmost corner of the West was sure that he beyond all others was storming the donjon keep of Satan.

This Jesuit storming party, full of hope and misnamed forlorn, roved at will without passports, while others, if they lacked such credentials, were put to death.

Their first acquaintance with mosquitoes is thus recorded: "The woods were full of a species of flies similar to the gnats which in France are called cousins (that is, I suppose, 'poor relations'). They are so importunate that one always has a multitude around him watching for a chance to light on his face or on some part of his body where the covering is so thin that their stings can easily pierce it. As soon as they light they draw out blood and substitute for it venom, which excites a strange uneasiness and a tumor of two or three hours' duration." When they first saw a fire-fly they must have thought like Paddy that a mosquito had taken a lantern in order to find his victims in the dark.

In sending their underlings into the heart of New France, Jesuit superiors were assured they could there repeat those miracles of conversion and reconstruction which their order had lately wrought in South America.

In Paraguay they had built up a model state. The natives became tolerant of their culture and compliant to their bidding in every particular. They rose and sought their beds, were married and given in marriage, weaned their children, removed from place to place, raised stock or grain, fixed prices, and used their gains at the dictation of spiritual guides. They were docile, but undeveloped, or developed only in some single prescribed direction. They were literally sheep, submissive when fleeced and even flayed and slaughtered at the pleasure of their shepherds. But their development was arrested. At their best they never became men, but remained children of larger growth, or rather became weaker in mind as they grew stronger in muscle. The purpose was to build up a second Paraguay in North America. An experiment, tried in Lower Canada, had failed. Its want of success was attributed to the roving habits of the tribes and the impossibility of persuading them to renounce nomadic life. It was tried again, with more sanguine hopes, on Lake Huron, for the tribes there were fixed through the year in one abode. When the Hurons had been overpowered by foes and driven into Wisconsin, the experiment was repeated there.

The westward exodus of Hurons into Wisconsin began as early as 1650. Onward from that time the French became known there, and that most favorably, as a race superhuman in arms, in arts and in benevolence. Such must have been the report concerning them which fell from the lips of fugitive converts. It roused the braves on the farthest shores of the farthest lakes to set sail in quest of the admirable strangers.

Missionaries were the more encouraged to venture far west; thanks to *invitations* from the aborigines. As early as 1611, the first fleet of Hurons that descended the St. Lawrence to meet Champlain said to him, "Come to our country, teach us the true faith." In 1633 it is chronicled that Hurons vied with each other for the honor of carrying missionaries home with them in their boats of bark. The volume of Jesuit *Relations* for 1640, states that fathers, invited by Algonquins on Lake Superior, were on the point of pushing forward even to that most western sea.

In 1679 an Outagami chief, espying friars among La Salle's company near Chicago, cried out: "We love those gray robes. They go barefoot as we do; they care nothing for beaver; they have no arms to kill us; they fondle our infants; they have given up everything to abide with us. So we learn from our people who have been to carry fur to French villages."

Stations far inland and dissevered from their base on the seaboard, were also preferred as being undisturbed by the influx and influence of non-missionary and anti-missionary whites,—godless sailors who swarmed on the rock of Quebec,—and above all from the heretical psalmody of Huguenots which could not there be silenced.

Aside from the moral advantages of a mission in the heart of the land, the fathers and their employes, whether paid or volunteering without pay, were most numerous and useful when remote from other whites, because they were able to push trade in fur, free from competitors. The lay brothers together with brandy sold scapularies or belts of the Virgin which were of such sovereign virtue that nobody who wore one at his death could possibly sink to perdition. The missionaries, according to Governor Frontenac, wished to keep out of sight the trade which they always carried on in the woods. They also claimed that their profits never exceeded five hundred per cent. Parkman wrote his *Jesuits* more than a decade ago. He was then doubtful whether those missionaries engaged in fur trading. But the letters of Frontenac, often written in cipher for secrecy (lately discovered by P. Margry and published by our congress), leave us no doubt on this point. In 1674 he wrote Colbert that when he urged the Black Robes to labor near white settlements, they answered that their coming into America was to indoctrinate savages — or rather to draw in beaver. He accuses them of dealing in peltries. In 1682 La Salle wrote that the Green Bay Jesuits held the real key of the castor country, while their blacksmith brother and his two helpers converted more iron into fur than all the fathers could turn pagans into proselytes.

A further narrative by La Salle regarding Jesuit tactics, reads as follows: "A savage named Kiskirinaro, that is to say, Wild Ox, of the Mascoutin tribe, a considerable war chief among his people, says that in a little river to which he wished to lead me, he had picked up a quantity of white metal, a portion of which he brought to Father Allouez, a Jesuit, and that brother Giles, a goldsmith who resides at Green Bay ("the bay of the Puans"), having wrought it, made the sun-shaped article [soleil] in which they put the holy bread. He meant the ostensory which this same brother has there made. He says that Father Allouez gave him a good deal of merchandise by way of recompense, and told him to keep the matter secret because [the metal] was a manitou — this is to say a great spirit who was not yet developed."

Nor were the most distant fathers altogether at the mercy of savages. A seminary for Huron boys at Quebec was projected in the outset, and was begun in 1636, two years before the building of Harvard College. One reason for founding this educational institution was that the Indian children in this Do-the-Boys Hall, would be hostages for the safety of missionaries, however distant in the interior.

It is a merciful ordination of Providence that the tragic suggests the *comic*, and all miseries have a ludicrous side.

The crew of Captain Nares in quest of the North Pole would have died of hypo in a darkness which outlasted a hundred times the space that measures day and night to us, had they not dipped deep in comic theatricals. Nor in the worse than Arctic gloom around them would the Jesuits have fared better, had not their eyes now and then rested on a silver lining of their sable cloud. Burdens, otherwise too heavy, they threw off by sportive notes in their diaries. Thus they must have felt a grim pleasure in writing down skunks as *infants of the devil.* Father Allouez relates that while publishing the gospel in the midst of Wisconsin he found himself in a sort of monkey France. Certain of the sequestered natives having carried beaver to Montreal had there beheld military pomp. Wishing to pay the missionary fitting honors, they stuck feathers in their hair, and organized the naked braves into a militia company who gravely mimicked every evolution of the governor's guard. The Jesuit discoursed to them of heaven and hell, but the unseasonable parody of French parade did not cease for an instant. The Black Robe could not keep his countenance, but his guard of honor did keep theirs. Every savage executed every punctilio of his part with more than Spanish gravity.

When an Indian had been so scalded as to lose the skin of his face, a Jesuit writes: "It would have been very well if he had lost his old heart with his old hide."

Another Huron, finding no missionary assurance that there was tobacco in heaven, declared he would never go there. The reflection chronicled by the Father is: "Unhappy infidel! all his time spent in smoke and his eternity in fire."

Robes and ritual inspired a divine awe. This was sometimes betrayed in odd ways. No Black Robe's risibles could remain unmoved when he overheard converts who feared to address a missionary, but asked the most solemn questions of his dog.

Again, certain Christian Indians having caught a warrior of a heathen tribe, named Wolf, the Jesuits let them burn him, having first instructed and baptized him. Then with a pun on his name they recorded it as a marvel indeed, that a Wolf was at one stroke changed into a lamb; and through the baptism of fire entered at once into that fold which he came to ravage.

Priestly humor was sometimes *unconscious.* Thus Hennepin remarks that no sooner had he declared a fraction of the heroic virtues of "the most high, puissant, most invincible" (Almighty? no! but) King of France, to savages" than they at once "received the gospel and revered the cross."

Again when he had set forth certain mysteries the Indians told him some of their fables. But these, he told them, were false. Their answer was, we believed your lies; had you been as polite as we were, you would have believed ours." Again, the question whether the quid of a tobacco chewer, taken in the morning before mass, broke his fast, was discussed pro and con by casuists. To them it seemed a question altogether serious, however ludicrous on all sides it appears to us.

Again, when they noticed that a certain *beardless* priest was a special favorite with natives, they sent to France for pictures of Christ painted without a beard.

After some analogous scrutiny of Indian tastes they wrote in their next order for paintings, "one view of celestial rapture is enough, but you cannot send too many scenes of infernal torments."

Again, "if three four or five devils were painted torturing a soul with different punishments, one applying fire, another serpents, another tearing him with pincers, another holding him fast with a chain, this would have a good effect, especially if everything were made distinct, and misery, rage and desperation appeared plainly in the victim's face."

Within fifteen years after Jesuits began work in earnest among Hurons, that tribe was either annihilated or expelled by the Iroquois. But for that catastrophe the faith of the Jesuit might have been to this day more dominant in Upper Canada than it is in Lower.

Some tincture of it has survived everything in all Indian dispersions. One of the first English adventurers to Maine was greeted by the natives with a pantomime of bows and flourishes which in his judgment could have been learned of nobody but a Frenchman. The aborigines in general were inoculated with French faith and French fashions so that they took about as much of one as of the other,—and not much of either. Disciples who ran wild in the woods retained some prayers and chants learned by rote. The divine vision which roused Pontiac and his compatriots to war, was a woman arrayed in white. Had they not been taught concerning the Virgin Mary, it could hardly have taken this form. In 1877, a white man who had been caught by a Rocky Mountain tribe chained to his wagon-wheel and half burnt, when he made the sign of the cross was snatched out of the fire. The hunting camps of tribes in Manitoba are to-day called Missions.

Missionaries, then, burning to propagate their faith, more than two centuries ago penetrated into our Northwest, some of them into Wisconsin. They there discovered tribes having fixed abodes, over whom their knowledge and tact gave them power, so that they molded them as clay in the hand of a potter, where their influence was unchecked by white intruders, and where they could so trade as to make their enterprise self-supporting.

The *third* stepping-stone of the French into the northwest, and thus into Wisconsin, was *fur*.

The fur trade would have drawn them thither, even if fun and faith had not paved their way. Indeed, that trade began to attract them to American shores before either fun or faith had worked at all in that direction.

After all, *fish* was the *first* magnet which drew Frenchmen across the Atlantic. According to a manuscript in the library at Versailles, when Cabot (before Columbus had landed on continental America) discovered Newfoundland, he heard the word *baccalaos* there in use for "cod-fish." But "baccalaos" is the Breton-French word for that fish. It is possible then that Bretons, next to the Norse, were the true discoverers of America — pre-Columbian and pre-Cabotian.

However this may be, fish, indispensable for fasts and not unwelcome at feasts, were sought by Bretons off Newfoundland, a century before Quebec was founded. In 1578, there were one hundred and fifty French vessels there.

But peltries, already scarce in Europe, filled the land in that quarter no less than fish the sea, and were hunted as early. Before the close of the sixteenth century, forty convicts, left on a Nova Scotia island, had accumulated a quantity of valuable furs.

But, what is far more surprising, Menendez relates that fifty-five years before the landing from the May Flower — in 1565 — buffalo skins had been brought by Indians down the Potomac, and thence along shore in canoes to the French about the St. Lawrence at the rate of three thousand a year.

But not content with coast traffic, and with a view to escape the rivalry and hostility of Dutch and English, as well as in quest of *fresh* fur fields, traders pushed inland. Before the year 1600 they had a post at Tadoussac, at the mouth of the Saguenay, and in 1608 established themselves at Quebec.

To this emporium Indian flotillas, year by year larger and larger, and from districts more and more remote, resorted. They came laden with furs, and drawn thither by what they counted miracles of beauty and ingenuity, which, bartered on the coast by the first comers, had glided up the St. Lawrence and all its tributaries, and even to the great lakes, where beaver were most and best.

They were further attracted by the presents and invitations of Champlain, who, in 1615, within seven years after the first tree was felled at Quebec, had held councils on Lake Huron, and bidden the natives to bring down their furs. Western Indians were still more stimulated to traffic by adventurers, who, as we have seen, had in 1609 begun to be domesticated among the aborigines and to share their hunts. Wrapped in furs, striding on snow shoes with bodies half bent, through the gray forests and frozen pine swamps, among black trunks and dark ravines, these young Frenchmen, though they meant not so, were commercial travelers, and they fulfilled their mission as shrewdly as those who now sally from Chicago. Those Chicago emissaries are dextrous dealers, yet very possibly might learn some *new* tricks of trade could they recover the lost arts of their forerunners whose palace cars were bark canoes, and their commercial hotels wigwams. Drummers from the lake-metropolis now encounter men of their own stamp from St. Louis. So did the early French agents conflict even in Illinois and Michigan with those who had been dispatched from the Hudson. In order to get beyond New York competitors, the French hurried still further *west* than they otherwise would have ventured.

Again, these roving and fraternizing Frenchmen did not long go among the aborigines empty-handed, or even selling by samples. They took with them into the heart of the land those goods — light and cheap — for which the Indian demand was the greatest.

At sight of an iron hatchet, says Perrot, Wisconsin tribes raised their eyes blessing heaven for sending them a race able to furnish so powerful a deliverer from all their woes. Every bar of iron was in their eyes a divinity. But *brandy* was from first to last the one thing needful in a trader's outfit. It was indeed contraband according to the dignitaries of both church and state. Yet then as now it had free course on some underground railroad. It was more easily *carried* because, before exposed for sale, it was *watered* as profusely as the stock of our railroads. Each gallon of proof liquor swelled to six. The lowest *price* for brandy was a chopine for a beaver skin. How much a French chopine amounted to you cannot easily learn from books. French and English measures were incommensurable. But what I long sought in vain, I have learned from the casual remark of an ancient fur-trader, that a chopine was so small a quantity as would not make an Indian drunk more than *once*. An Indian is quite unlike an *Irishman*. But in one thing they agree. Neither is consciously guilty of a bull when he says: "Give me the superfluities of life and I will give up the necessaries. Traders too scrupulous to sell liquor to an Indian, would still exact a beaver of him for a single four pound loaf of bread.

French commercial men bore a *charmed* life. The fiercest savages spared both them and their goods, lest no more of that desirable class should come among their tribes. They had too much *wit* to kill the geese who were their only hope of golden eggs. La Salle's testimony is: (M. 2,284.) "The savages take better care of us French than of their own children. From us only can they get guns and goods." Hennepin relates that he would have been scalped by his Indian captors had they not judged that his death would hinder others of his countrymen from bringing them iron.

French traders soon brought with them more merchandise than they could transport overland. They were thus led to establish trading *posts* on navigable streams and at carrying-places. We naturally think such commercial stations would be set up first along the *St. Lawrence* and *Lake Ontario*, those natural highways to and from the west. They were *not*. Those waters were watched by the *Iroquois*; fiercest in fight of all Indians, foes of France, allies of Holland and England. Accordingly the thoroughfare of western Indians to Quebec and of French traders to the upper lakes, was by the *Ottawa*, a river which, lying farther north, was comparatively safe from Iroquois ambuscades, which were with reason more dreaded than cold, famine, storm and cataract.

Hence it came to pass that the French while they still knew nothing of Lake Erie and Niagara, were familiar with Lake Superior. Two of their traders had penetrated into that inland sea in 1658.

Even after the French were at peace with the Indians on the south of the St. Lawrence and Lake Ontario, they were no match on those waters for Dutch and English rivals in fur trading. The latter could afford to pay four times as much for furs as the French could. Nine pence was the export duty on a beaver at New York; in Quebec it was six times as much. In New York fur-trade was free. At Quebec seven hundred crowns were charged for permission to send a single boat up the Ottawa. Good reason then had the French to seek furs so far northwest that they could escape European competitors.

The result was that they had reached Lake Huron in 1615, and soon hurried on to Michigan, while they had no port on the nearer lake, Ontario, till two generations afterward in 1673, when they threw up Fort Frontenac at its outlet, where Kingston now stands. Its builder, Frontenac, intended it merely as a base of operations for fur trade so far west that he would be independent of the governor of Montreal. Seven years afterward in 1679, La Salle, having launched the first sloop ever built on Lake Erie, voyaged in her through St. Clair, Huron and Michigan to the mouth of Green Bay.

His vessel was there freighted with rich furs, but as she was lost on her first passsage eastward, La Salle's experiment did not recommend the lower lakes. On the contrary it tended to make the upper, or Ottawa route, more popular than ever.

The doors into Wisconsin were two,— La Pointe and Green Bay, and these two were about equal favorites. The first missionary arrived at La Pointe in 1660. Fur traders came *with* him. Nine years after, in 1669, when Father Allouez reached Green Bay to found a mission, fur traders were on the ground, and had become so domineering in that end of the world, that the missionary was brought by the Indians from Lake Superior as a protector.

Nicholas Perrot, who in 1683 built a fort near the mouth of the Chippewa river, though on the west bank of the Mississippi, had entered Green Bay eighteen or twenty years earlier. He wrote a volume,— not for publication — but for the information of the Canadian government. In this work which was first printed less than twenty years ago, in 1864, he describes a score of journeys in all parts of Wisconsin, all of them having something to do with fur. How fully even in his lifetime the region between Lake Michigan and the great river had become known to the French, is plain from the early geographical *names* being largely French.

Le Sueur, who passed up the Mississippi in the year 1700, mentions between the Wisconsin and the St. Croix, six rivers with French names, all apparently of long standing. These rivers were Aux Canots, Cachee, Aux Ailes, Des Raisins, Pasquilenette and Bon Secours. In other parts of Wisconsin not a few French names run back as far as these on its western border.

In 1654 Father Le Mercier at the outlet of Lake Superior wrote that about Green Bay, nine days' journey distant, there were Algonquins, and that if thirty French were sent there they would not only gain many souls to God but would receive pecuniary profit, because the finest peltries came from those quarters. The next year fifty canoes of these Indians visited Quebec, and thirty Frenchmen returned with them. Among Ottawas between Green Bay and Lake Superior French traders are mentioned in 1659. In 1665 Perrot was buying beaver of Outagamies in or near the Wisconsin county in the name of which they still live, and in the following year the second flotilla of Pottawatomies had reached Montreal.

French fur-factors penetrated the further into western fastnesses, because by this means they practically enjoyed *free-trade.* Making bark canoes far inland they evaded the crushing imposts on all canoes allowed to pass up. While mother-states were all at war, they plied friendly commerce with Dutch and English middle-men as well as their Indian confederates. Thus their beaver were either exported through New York, dodging the French tax, or they were bartered there for blankets cheaper and better than were to be had in Canada.

As a rule the French governor and intendant were at swords' points with each other. Each would charge the other with a heinous offense—carrying furs to the English province. The truth is that each of them was determined to be the *only* sinner in that line. Each thus resembled the usurer who was delighted with a sermon against usury, paid for *printing* it and said to the preacher, "Make *more* such discourses! Stop everybody from taking high interest — except me. Then I can monopolize the whole business." As his recompense for risks and outlays in western discovery, La Salle asked nothing but the exclusive right to sell the skins of buffaloes.

Royal monopolies of fur-trading, lavished in Paris on court favorites or on corporations as the Hundred Associates, *crippled* that traffic near the *coast.* But they drove the bulk of that business into the *heart* of the continent, where it fell into the hands of traders so distant, shrewd and self-sufficing that it could not be crippled. Over a region vaster than any European kingdom, the bush-rangers carried on the fur-trade after their own pleasure, and laughed at royal restrictions on their dealings.

In 1681 Hennepin, at Mackinaw, met with forty-two Canadians who had come thither to trade in furs, defiant of the orders of their viceroy. These foresters were not without a sort of *conscience*, for they all begged the Jesuit to give them the cord of St. Francis, which was believed to make their salvation sure if they died wearing it as a girdle, and they all gained their request. Hennepin was then journeying eastward from Green Bay, where he had been entertained by the same class of contraband traffickers. There similar adventurers — La Salle informs us — had a permanent post in 1677, and that bay had even been visited by a brace of voyagers more than twenty years before, in 1654. Before La-Salle began his explorations in 1679, his employes were familiar with far western tribes. One of them, Accault, had spent two winters and a summer in Wisconsin. Before 1680, *Duluth*, with a score of followers, was trading as far inland as the city which now bears his name. He proclaimed that he feared no authority and would force the government to grant him amnesty. (M. 2, 251.) The sloop which La Salle in 1679 had dispatched to Niagara before he started from Green Bay for Illinois, according to his conviction was scuttled by her crew, who plundered her and struck into the northwestern wilderness, meaning to join hands with Duluth. (M. 2, 327.) Years afterward La Salle heard of a French captive on the upper Mississippi whom he identified as his pilot, and learned that hand-grenades, which could only have come from the missing vessel, had been taken by savages from that captive.

In order to buy cheaper of Indian trappers, wandering fur hunters would report *pestilence* as prevailing in Montreal, and thus frighten savages from paddling down the river. Such fur-factors were outlawed on the upper lakes, and they could not dam up their outlets, but they intercepted many a flotilla anxiously expected from above in Montreal. Thus masters of the situation, they resembled those cunning Athenians who Aristophanes tells us were suspended in a sort of balloon, stopping incense as it rose from Jove's altars, and letting no savor of it reach Olympian nostrils, but keeping all for themselves.

On a long march every thing not totally indispensable is dropped. Hence the far western dealer carried no scales or steel yards. But he was himself a better weighing machine, for himself at least, than any witty invention of Fairbanks with all Howe's improvements superadded. So the saying was about Duluth: "Duluth, an honest man, bought all by weight, and made the ignorant savages believe that his right foot exactly weighed a pound. By this for many years he bought their furs, and died in quiet like an honest dealer."

In selling to Indians, however, the pound was no doubt quite a different weight. In the journal of a missionary at the outlet of Lake Superior I find that in 1670 a beaver was there valued at either four ounces of powder, or one fathom of tobacco, or the same length of blue serge or six knives.

Wood-ranging fur men seemed an evanescent race. Nevertheless they outlasted French empire in America. In latter times when English and Yankee fur-companies were organized in Montreal and New York they were unable to dispense with the French operatives, "to the manner born." Generation after generation they retained them as practical men fittest for all works relating to fur. In all governmental departments the higher functionaries, when first elected (and too often to the very end of their career), need to be taught official routine. Hence officials of lower grade who have learned to run the machine, are retained without regard to political revolutions. These factotums are significantly called "dry-nurses." Such dry-nurses for English and American fur kings were discovered in French underlings.

Fun and faith both gave a new impulse to the fur trade. With it they formed a three-fold cord which drew the French from end to end of the Mississippi, as well as to the farthest fountains of the St. Lawrence, and even further. La Salle deserves deathless fame, and will have it, because he was first to follow the Mississippi down to the gulf. But his grand object was to secure an outlet for fur that was not half the year frozen up, and the other half infested by English rivals, Iroquois ambushes, and worse than all, Canadian farmers of the royal revenue. Duluth, whose name we have seen revived and bestowed on a mushroom metropolis, "the zenith city of the unsalted sea," two centuries ago had penetrated beyond the farthest corner of our innermost and uppermost lake. His mission was to intrigue and foil the English on Hudson Bay. Ere long a French fort rose on the Saskatchawan, two thousand miles, as men traveled, from the seaboard. This station came up under the auspices of the French Company of the Northwest, incorporated in 1676, in antagonism to the Hudson Bay Company, which came into existence six years earlier. It long bore sovereign sway over a wide savage domain.

The natives preferred the manufactures of the English, but the manners of the French. Like all savages, they were swayed by impulse more than by interest. They would give more for one plug of tobacco brought to their wigwams than they could buy twenty for in Albany or Hudson Bay. Hence they traded with the French, and became their tools. One result was that in 1684, and again three years after, Nicolas Perrot, the supreme fur trader and Indian negotiator of his time, persuaded five hundred Indians from Wisconsin and near it to paddle their canoes all the way to Niagara in order to fight for the French.

In 1724, Bourgmont was already exploring the Upper Missouri. But on this line of Western research Verendrye outstripped all others. Pushing on step by step for ten years, he discovered the Rocky Mountains in 1743 on New Year's day, sixty-one years before our Lewis and Clarke. The point of his discovery was just above where the Yellowstone joins the Missouri. That region was so full of fur that the governor's share in the profits of a trading company soon amounted to 300,000 francs.

Those who, from mere love of fun, explored unknown woods and waters, learned strange tongues and ceased to be strangers among strange tribes, and unawares acquired all the requisites for successful commerce in beaver. Missions also, though founded in faith, by faith and for faith, furnished as good a base for the enterprises of furriers as if they had owed their origin to the spirit of mercantile speculation.

There is no danger of overrating the pervasiveness of French fur dealings in the Northwest centuries ago. We may well believe no cove, no navigable stream was unplowed by their boats of bark; no tribe, no council unvisited.

The demand for fur in France was stimulated by royal decrees. In 1670 one of them prohibited the manufacture of demi-castors, a sort of hats that were only half made of beaver. Soon afterward a prohibitory duty was laid in France on all furs not from French colonies.

Statistics are stupefying, and there is some wit in the quip, "A fig for your *dates!*" After all a few figures are necessary if we would understand how speedily and how grandly the trade in skins was developed, or how long and how widely fur was king as truly as cotton or corn has become so in our times.

In 1610, ten years before the landing of the forefathers at Plymouth, the boats of fur traders were at the outlet of Lake Champlain. Three years after forty canoes came down to Montreal bringing fur. In 1690 their number was 165; three years after, it rose to two hundred. For a decade before 1649, the Huron beaver harvest was valued at half a million francs a year. Fifty francs would then feed a man for a twelvemonth, and one hundred and fifty would pay a soldier. In 1674, the skins imported into Rochelle were 311,315. The governor of Montreal, whose salary was a thousand crowns, soon cleared fifty thousand by illicit fur dealing.

As early as 1670 there is mention of a fur fleet embarking at Green Bay for Montreal. Even before this, as we have seen, adventurers to Wisconsin waters and its interior, paid the charges of exploration by an incidental trade in fur. Just afterward, the first Indians whom Marquette met on the Mississippi, were wearing French cloth. During the winter of 1674–5, when that missionary lay sick at Chicago, two traders were already encamped in the vicinity.

For more than a hundred years, the Northwestern beaver trade flowed on with a colossal and all-pervading stream. In 1791, the skins collected there for Montreal merchants amounted to more than half a million (565,000). A few years after John Jacob Astor, "sagacious of his quarry from afar," engaged in this traffic with hundreds of boats, thousands of men and millions of capital. Green Bay was his point of departure, as Mackinaw had been that of the French for many generations. But his employes pushed through the continent to the western ocean. Most of his fortune came from fur, and it would have been twice as large, but for the war of 1812. But even Astor's fur agents of all classes were largely descendants of French voyageurs who had taken up their abode in the Northwest ages before.

Falsehood and false fancies were also among the forces which first hurried the French far west.

It is through no longing for alliterative initials that I add false fancies and falsehood as a fourth force to fun, faith and fur. At that period all travelers, if not Munchausens themselves, believed Munchausen stories, and when people are willing to be deceived, they are deceived. Demand for lies never lacks supply.

One Frenchman in Florida, when he saw a squaw so wrinkled that there was no room for one furrow more, believed the report that she had outlived five generations. Another, near Newfoundland, landed on an isle of demons not without wings, horns and tails. A third, when certain Canadian chiefs told him of a race who had but one leg and lived without food, took them to France for repeating their story to the king. These were sons of men who had been credulous to Venetian merchants, who, selling spices for their weight in gold, advertised them as no product of the vulgar earth, but plucked from branches thrown down from the battlements of Eden by compassionate cherubim. The age of faith was not yet over. As recently as the last year of the seventeenth century a company formed in France to work a mine of green earth reported to exist at the sources of the Mississippi, sent a party of thirty miners up that river. Their voyage up stream lasted ten months.

Among the earliest volunteers from the retainers of Champlain to ascend the Ottawa with savages, who had descended from a country no white man had ever trod, was Vignan, in 1610. On his return next season, he declared that he had pushed on to a salt sea, seen the wreck of an English ship, and heard of Cathay and Zipango,— so China and Japan were then called — as not far away.

The spark fell in gunpowder. Champlain heard not only what he wished to believe, but what all men of his time and a century after held for certain, that a short Northwest passage to the East Indies existed, and would at once double the wealth of any nation which could appropriate it by right of discovery. His own fleet had been equipped in 1608, not merely to colonize Acadia, but "to penetrate inland even to the Occidental sea and arrive some day at China."

He believed that in 1609 a vessel, clearing from Acapulco,— a Mexican port on the Pacific, lost its reckoning in a storm, but after two months found itself in Ireland,— and that the King of Spain had ordered the journal of the pilot to be burned so as to keep foreigners from knowing the course followed, but which was supposed to be north of Canada. The map of Verrazano, then still an authority, in addition to the Isthmus of Panama showed another no less narrow near the latitude of New York with the Pacific beyond it on the West.

More than three score years afterward, La Salle sought that East Indian route by way of the Mississippi. His estate just above Montreal was, and is still, called or nick-named, *La Chine*, that is China, because he started from there bound for the Empire of Celestials. Years after he had stood at the mouth of the Mississippi, he spoke of that river as separated from the China sea only by the breadth of the province of Culiacan, and was confident of meeting not far from the mouth of the Missouri, with rivers which flowed into the ocean he sought.

England shared in the delusion that the Pacific was near the Atlantic. Hence a barge was sent over to John Smith in Virginia with orders to row it up the Potomac, carry it over the mountains, and launch it on some stream that flowed into the South sea, which was afterward made the western boundary of Connecticut.

The truth is that French and English alike had a short cut to China on the brain. No sooner then had Champlain heard the story of Vignan than he hastened up the Ottawa with a crew of enthusiasts. Thirty five carrying-places and an infinity of hardships seemed nothing to him. When half way to Lake Huron — at the Isle of Allumette,— he detected the imposition which Vignan had practiced upon him. Champlain was more magnanimous than certain prospectors lately led into the Black Hills by a guide who promised them diggings that would yield thirty cents a pan, and finding him a liar straightway strung him up on the nearest tree. Champlain was more disappointed than the prospectors — yet he forgave the impostor.

The next year, 1615, taking a fresh start, he reached the head of the Ottawa, crossed to Lake Huron,— held councils with divers nations on that inland sea, hearing of still other seas beyond — and saying to one and all: "Bring furs down to Quebec and show me the way to China." Plainly he thought one request as easy to grant as the other.

The name of the first Wisconsin tribe with which the French became acquainted, and that before 1640, namely, *Winnebagoes*, was understood by them to signify *Saltwater* men, and western saltwater they associated only with the Pacific. Nicolet, the first white man on the Wisconsin (?), having voyaged down that river within some five and thirty leagues of the Mississippi, believed himself within three days march of the great sea of the west.

The Indians were always notorious for reporting whatever they perceived that whites desired to hear. They thus hoaxed them all alike. Spaniards they tickled with stories of gold, New England Puritans by legends concerning the Great Spirit, and so they amused the French, who came with a passion for China, with accounts of a Celestial empire.

At that era various nations were rivals in searching for new routes to China,—the English through Hudson Bay, the Dutch north of Lapland, and the French by way of the Great Lakes. They had all been denied access to the East Indies either by the Cape of Good Hope or of Horn,—which Spain and Portugal respectively blockaded, treating as privateers all who tried to pass. But their hopes were sanguine of finding another road thither, as the Italians when at the fall of Constantinople cut off from their mediæval thoroughfare eastward from the Levant, had set their faces westward and discovered America. The spirit of the age, "the grandeur of which," Froude pronounces "among the most sublime phenomena which the earth has witnessed," felt that only a corner of the veil had been lifted. All past findings just gave enough to wake the taste for more.

Champlain was the more thoroughly persuaded that the Pacific was near Lake Huron because he had himself beheld Pacific surges at Panama, the longitude of which is not so far west as that lake by a dozen degrees. His sight strengthened his faith, which was never weak. Quartz pebbles picked up on the river bank at Quebec he thought diamonds, and gave the rock above the name it bears to this day — Cape Diamond.

On Joliet's return from down the Mississippi, Frontenac's first feeling was regret that that river had not borne the explorer to the Pacific and to Japan. His next emotion was hope that the Missouri — still anonymous, but called by Joliet a northwest branch entering the Mississippi in latitude 38 degrees — could be ascended to a lake with an outlet into the Vermilion Sea — his name for the Gulf of California. Seven years later, in 1680, Duluth, near the head waters of the Mississippi, heard of Hennepin as a captive among the Sioux. He sought him out, procured his release and escorted him to Green Bay. But for this call to a mission of mercy, "my design was," says he, "to push on to the sea on the northwest, believed to be the Vermilion Sea, from which a war party had come among the Sioux. Some of its salt they gave to three Frenchmen that I had sent out as a scout, and they brought it to me. According to their report it was no more than twenty days' march to a great lake the water of which was not fit to drink, and which I had no doubt I could reach without difficulty."

But all varieties of Frenchmen in America — the fur-hunter, the votary of fun and frolic and the apostle of faith — whatever their primary impulses, each man was inspired to dive further into the west, by a lurking but fixed idea that he was himself the predestinated Columbus of the grand discovery — that portal through which men should bring the glory and honor of the nations to and from farthest India — that world's highway which lay hid from princes and plebeians till in the fullness of time California opened wide her Golden Gate on golden hinges turning.

Only those of us who remember when California burst on the world like a sun-burst, or lightning shining from the west unto the east, as El Dorado no longer fabulous, can understand the fever and frenzy which burned in every man who set his foot toward the western unknown; his assurance that he was to be the revelator, not of an ignis fatuus or desert Nile fountain, but of greater marvels than are dreamed of in all the Arabian Nights — a fairyland where urchins play at cherry-pit with diamonds, where country wenches thread rubies instead of rowan berries for necklaces, where the pantiles are pure gold and the paving stones virgin silver. For such merchandise who, though no pilot, would not adventure to the farthest shore washed by the farthest sea?

"The blood more stirs to rouse a lion than to start a hare." Accordingly the illusions, that sheening far celestial seemed to be, of the China-seeker, the missionary and the fun-lover, yes, of the fur-dealer, roused them to efforts and crowned them with successes they could never have made had they seen things as they really were.

Celestial visions flitting always a little ahead of western wanderers were an analogue of Sydney Smith's patent Tantalus. This was a bag of oats hung on the pole of his carriage. It rattled before the noses of his horses, but was about a foot beyond their reach. In both cases, also, the stimulating influence was very similar.

Another French foundation was laid in the far west by political *finesse* and *feudalism*.

The apostles of faith were also political intriguers. They knew that nothing but the supremacy of France could afford a basis for permanence in their missions. Accordingly, of themselves they worked for French domination as for self-preservation, and they were often formally appointed ambassadors.

Moreover, they sometimes established a sort of theocratic feudalism, or oriental patriarchate, in which they were themselves lords paramount.

According to Parkman, "it behooved them to require obedience from those whom they imagined God had confided to their guidance. Their consciences then acted in perfect accordance with the love of power innate in the human breast.

"These allied forces mingle with a perplexing subtlety. Pride disguised even from itself walks in the likeness of love and duty, and a thousand times on the pages of history we find hell beguiling the virtues of heaven to do its work. The instinct of domination is a weed that grows rank in the shadow of the temple." (Jesuits, p. 159.)

Always and everywhere Jesuits have been charged with usurping political sway. In 1667, the Canadian Intendant, Talon, addressed a remonstrance to Colbert, the French premier, complaining that the Jesuits "grasped at temporalities, encroaching even on that police which concerned magistrates alone." This complaint related to intermeddling on the St. Lawrence. But on the Upper Lakes and beyond them, there could not be too much Jesuit domination to please French statesmen.

But another class of political agents were very early abroad in the west. Nicolet, whom I have mentioned as in Wisconsin in 1634, and probably the first white man ever there, had been dispatched to Green Bay as a peace maker between the tribes of that vicinity and the Hurons.

Soon after the year 1650 the Iroquois had vanquished all the tribes east of Lake Michigan. They expelled them from their old homes, and drove most of them beyond that lake, some of them even beyond the Mississippi. In this flight the Ottawas descending the Wisconsin, and pushing up the Mississippi some dozen leagues, entered the Little Iowa and sought an asylum on its upper waters. For those tribes who lingered in Wisconsin there was no hope of fighting the Iroquois fire-arms without fire-arms, and no hope of fire-arms except from the French. The governors of New France, to whom the Iroquois were sworn enemies,—at once saw the policy of lifting up these fugitives, uniting them in amity to each other, and to the tribes where they had fled for refuge, supplying them with kettles, tobacco, but above all with guns and powder,—in a word by every means stealing their hearts. For this end they dispatched into Wisconsin and further a species of envoys of which Nicolas Perrot was a good representative.

This Indian commissioner had been prepared for his functions by much western experience. He was first in Jesuit employ as a lay-brother, and then became an adventurer in quest of fun and fur where no white man's foot had trod. No doubt he was in make half Indian, and when present at a war dance would lead it, like Frontenac at three score and ten, whooping like the rest, or rather outwhooping them all. The Indians named him "Pop-corn," perhaps because when heated he seemed to them to grow ten times bigger, like the dwarf who declared that though his avoirdupois in the scale was ordinarily only one hundred and twenty pounds, whenever he got mad he weighed a ton.

His official career in Wisconsin began at latest in 1665. After making friendship with the Pottawatomies at Green Bay, he pushed up Fox River and into a lake of which it is an outlet. There he held a council with the Outagamies. After this fashion he went on for five years,—at home with tribe after tribe—at home in the customs and dialects of all the enormous angle between the upper Mississippi and the upper lakes. He brought many nations into a confederation with each other and against the Iroquois. His fame, like Solomon's, brought visitors into Green Bay from the uttermost parts of the earth,—some who spoke of trading with Mexican Spaniards and others who described white men far north in a house which walked on the water—meaning the English on Hudson bay. (2 178 La Potherie.) How he was borne aloft on a buffalo robe, reverenced for fashioning iron as squaws did dough in a kneading trough, and feared as holding in his hands thunder and lightning, we have seen already.

In 1671 he was interpreter for a dozen nations whose delegates largely through his persuasions then gathered at Mackinaw and acknowledged the sovereignty of France. His influence over them was seen in 1684, and again three years after, when, as I have before stated, he induced five hundred warriors from Wisconsin, and near it, to paddle their canoes many a hundred miles in order as allies of the French to fight against the Iroquois. According to Indian ideas his greatest exploit was delivering from torture and death a captive whom the savages had resolved to burn. No common miracle was it to make Indians forego the ecstasy of beholding and gloating on an enemy in agony. The French then aimed to make the western chiefs do homage to their king as a suzerain, and fight shoulder to shoulder in his battles.

But many adventurers from France also sought to become themselves a sort of feudal barons. To this end they secured patents of nobility with land-grants, termed seigniories. Some of these bordered on the St. Lawrence and Lake Champlain. But these eastern estates just gave enough to wake the taste for more. At the outlet of Lake Ontario La Salle possessed a domain stretching five leagues along the shore, besides others almost boundless on Lake Michigan, and whatever in other unknown regions he could conquer. As Col. Colt invented a patent revolver, so La Salle expected to hold as a patent-right the realm he had revealed. He was sanguine that his principality would be more attractive to immigrants than Canada. It was prairie which needed no clearing,— it was more fertile, of milder climate and more varied products, many of them — as salt, grapes and hemp — unknown in Canada. Not a few similar land-claims based on governmental grants were set up by French occupants when the United States assumed jurisdiction over Wisconsin. The Norman race which centuries before had feudalized all Europe, now meant to master the Mississippi Valley. French wanderers were not unfrequently elected chiefs of tribes. Perrot was so honored among nine different nations. French officers also came with a retinue of their own countrymen, whom they ruled by martial law, being sometimes judge, jury and executioners all at once. This one-man power, where no law was known but his will, was the secret of many a success. It inspired a salutary fear where the common law of England and even the civil law of continental Europe would only have provoked contempt.

At Frontenac La Salle wrought wonders. The natives were compliant to his will like clay in the hands of a potter. At his bidding they settled near his fort, cleared land, tilled it, worked on the fortifications and on houses, sent their children to school. According to Parkman, "seignior by royal grant of water-front for five leagues,— feudal lord of the forests around,— commander of a garrison raised and paid by himself,— founder of the mission,— patron of the church,— he reigned the autocrat of his lonely empire." Nor was he altogether destitute of feudal trappings,— for, according to his chaplain, Hennepin, on state occasions he wore a scarlet mantle laced with gold.

On the Illinois river his success was still more marvelous. The colony he there extemporized was reckoned in 1684 to contain 4,000 Indian warriors or 20,000 souls, like the peasantry of the middle-ages, clustered around his rock fort, "Starved Rock," perched high as an eagle's nest. The region around he had begun to parcel out among his followers.

Feeling equal to the grandest enterprises, he had longed for liberty to beard the Spaniard in Northern Mexico. Having been granted that liberty, had he not been betrayed on his way back to the Mississippi, he would bave made Starved Rock the strategic base of active operations against Mexicans. All the region between that post, styled St. Louis, and the South Sea, was subjected to him by his French commission.

Judging by such an experiment, and before the failures in this direction which followed hard after, it was not unreasonable to hope for founding feudal baronies far west with French retainers as henchmen of each dignitary, and a crowd of aboriginal vassals beneath all the whites; but supporting all by fur and farming in time of peace, and not less by filling the ranks in time of war. There still exists an early map of New France with a fort in every seigniory.

Enterprising Frenchmen, who aspired to the independence of a mediæval nobleman, must needs go west in order to find what they sought. No populous native tribes still survived east of Lake Huron. The French were hemmed in by the English and Iroquois on the south, while short days and long winters repelled them from the north. On the other hand, everything allured them westward — natural highways, mild climate, fertile soil, prairies that needed no clearing, buffaloes fancied ready to yield wool and draw the plow, friendly Indians, and — more than all — elbow room, safe from Canadian dictators. The founders of Montreal had been brow-beaten in Quebec. The vice-governor at Montreal was not very subordinate to the royal functionary at Quebec, but more so than the officials upon Ontario and further were to his own jurisdiction. They were their own masters.

In addition to this, French intrigues in the far west were multiplied and intensified by pecuniary interest. Nothing but political supremacy in that distant realm could assure prosperity in that fur-trade where lay their sole hope of money-making.

As soon as they had secured sway in any tribe they first said, "Bring all your fur to our factors!" This point gained, their second demand was, "Make your neighbors do likewise, peaceably if you can, but forcibly if you must." Thus it came to pass that many a brave was butchered to procure beaver for French whose policy was that of Æsop's monkey:

> "That cunning old pug everybody remembers,
> Who, when he saw chestnuts a roasting in embers,
> To spare his own bacon, took pussy's two foots,
> And out of the ashes he hustled his nuts."

Considerations such as these show how powerfully the finesse of political schemers and the ambitions of feudalism roused the French to penetrate into the utmost corner of the west.

The English also, as adventurers, traders, or both, tried to push into the farthest western wilds. But the French outstripped them, arrested their factors and explorers and treated them as outlaws. The motto of the French was:

> "It shall go hard,
> But we will delve one yard below their mines
> And blow them at the moon."

The French foundations in the Northwest proved failures. When French officers gazed at the charge of the six hundred at Balaklava, they cried out: "This is admirable, but it is not war." So French foundations in the Northwest were wonderful beyond all wonder, but they did not constitute a state, one whole body fitly framed together, which vital in every part cannot but by annihilating, die.

The first foundation was Fun. Fun taken in homeopathic doses is good, but it is by no means substantial food for a life-time much less for a nation's life. At all events it either finds or makes frivolous those to whom it is all inall,— labor and not merely luxury,— business as well as recreation. If all the year were playing holidays, to sport would be as tedious as to work. Savage life, however fascinating at a distance as to the novelist Cooper, or the sentimentalist Rousseau, loses romance when viewed close at hand as by Parkman domiciliated among Dakotahs — indeed by the sober second thought of any one capable of appreciating civilization and aspiring to progress.

The result was that French fun-lovers, either like Nicolet returned from their sportive sallies to dwell among their own people as well as educative and elevating institutions, or on the other hand, they sunk to the low level of the aborigines around them, perhaps degraded them still lower by the vices of civilization. The backwoods maxim proved true; that it is the hardest thing in the world to make a white man out of an Indian, while it is very easy to make an Indian out of a white man.

The apostles of *faith* also failed in the far west. Their want of success was due in part to the extermination by war and plague of tribes among whom they ministered, in part to inability to reclaim other tribes from nomadic habits, and in part to the nature of their teachings. Their exhibition of Christianity was rather spectacular than intellectual, more emotional than practical. Among their maxims I find these: "It is God's will that whoever is born a subject should not reason but obey." "Teaching girls to read is robbing them of time." They taught singing but not reading. No newspaper appeared in New France till after the British conquest. At an Indian college which had flourished for a generation Frontenac, relates that no student could speak French. In spite of all pains pupils proved Calibans on whom nurture would never stick. Of one that was taken to France at a tender age, baptized, and learned French well, I read that when brought back to Canada as an interpreter, he became as rude a barbarian as any one and held fast his barbarism to the end.

If the Jesuits had had free course on our Upper Lakes, the result would have been nations submissive but not self-sufficing, peaceable but unable to defend themselves — having the *personnel* of men but the puerility of children. They had an ordinance to hasten the *physical* weaning of Indian children — but their mental weaning they would never permit.

Frontenac's report to the home government was: "The Jesuits will not civilize the Indians because they wish to keep them in perpetual wardship. Their missions are hence mockeries." They censured La Salle because at his fort he had some fifty Indian children taught to read and write.

Compared with the sturdy Puritan, the self-reliant Yankee, the products of Jesuit training would seem those legendary monkeys who were intended to be men, but whose creation being begun on Saturday afternoon, was interrupted by the coming on of the Sabbath, so that they were sent into this breathing world scarce half made up. Their development remains arrested still. Well is it said: "A man to BE a man must feel that he holds his fate in his own hands."

However Jesuits might have succeeded, in blowing up a bubble, bright and polished as glass and iridescent with rainbow hues, it must have burst at the first rude shock from without, as did the insubstantial pageant which they conjured up in Paraguay.

A heretic would say that their system had not truth enough in it to make a lasting lie. Hence it was, "The perfume and suppliance of a minute."

The *fur-trader* rejoiced in a longer success than either the votary of fun or the apostle of faith. But *his* occupation too was gone at length. Fur-bearing animals vanished even sooner than the forests that sheltered them.

Fish began to be taken in Canadian waters before the first furs were trapped on Canadian shores. The fish continue now as multitudinous as ever, while the fur is no more found. Five and a half millions have we recently paid for the right to fish in Canadian waters.

Crops springing out of the bosom of the earth are exhaustless like a living spring. Beasts wandering over its surface, or living in its dens, pass away, like desert streams in summer, and what is worse, are never renewed as those streams are.

Beaver Dam as the name of a city in Wisconsin may always endure, but the cunning handiwork of the beaver, chief favorite among fur-bearers, is to day scarcely discoverable in all the State. The beaver's gone beyond redemption, gone with a galloping consumption. Not all the quacks with all their gumption, will ever mend him.

The chief Yankee staple was fish; that of the French was fur. The contrast between the races was palpable. Accordingly the natives named the Yankees *Kinshon*, which signifies "fish," and the French *Onontio*, that is, "Big Mountain." The latter name may have been suggested by Gallic pomposity. But after labors manifold the mountain brought forth a mouse, and the fish swallowed him.

The victims lured on by falsehood or false fancies in pursuit of a short cut to the farthest East, were no less heart breakingly disappointed than the men of fun, fur and faith.

Their chase in the West of an ever-fleeing East, reminds me of De Soto chasing the phantom of a rejuvenating fountain. Both long roved in a fool's paradise, but at length wasted sinewy vigor, like thirst-parched pilgrims, running after the mirage when the sultry mist frowns o'er the desert with a show of waters mocking men's distress.

But after all both achieved great discoveries, like alchemists, not of what they sought, but of whatever was to be found. De Soto discovered the lower Mississippi, and French visionaries the upper, its head-waters, the Yellow Stone and the Rocky Mountain backbone of the continent. They were the first who ever burst into our inmost shrines.

But their aims were *low*. At its best their ideal was not to *found nations* circled by all that exalts and embellishes civilized life. It was merely to discover a thoroughfare to the Pacific and the Indies ready made to their hands. This ideal was never realized, and under the old regime of the French it never could be.

To make such a pathway, or rather more than royal highway was a beau ideal reserved for the Anglo-Saxon of our times, and his ideal was straightway actualized,— the firstlings of his heart became the firstlings of his hand. Some of us cannot worship the heroes of our trans-continental roads. Even we, however, must admit that but for their iron will we should even now rejoice in no iron ways.

Indians and French — path-finders like Fremont — were a vapor that appeared for a little time — at most an Indian summer.

Yankees brushing them away, working mines of lead and lumber, and then extracting agricultural wealth yet more perennial and wide-spread, have built on firmer foundations, and are efflorescing in a higher style of culture throughout all departments of life.

The French who occupied the Northwest either as missionaries among Indians, and those bound by vow to celibacy, or who adopted Indian ways of life, naturally proved a race no less ephemeral than the natives themselves. They vanished all the sooner because they entered that region in small numbers. Indeed French immigrants were nowhere numerous in America.

But had one single feature of French policy been different, the change in American history would have been great beyond calculation. Huguenots, the only class of Frenchmen ready to leave *France*, were not permitted to enter New France. Had they been welcome there, legions of them would have penetrated its wilds as far as any fanatical Jesuit or jolly rover. They would have outnumbered the English Americans, being driven abroad by worse persecutions at home. They would have furnished material for such agricultural and manufacturing centers on the Upper Lakes as La Salle vainly strove to found in Illinois.

In the next place, most of those French refugees who enriched Switzerland, Holland, Germany, England, and divers British colonies, especially those on the Atlantic coast, with new arts or old ones plied with new skill, would have betaken themselves to Canada. There no strange language nor strange institutions repelled them. They never willingly expatriated themselves, and in New France they would have seemed still at home. It has not been enough noticed that New France was at first founded by French Protestants, and that the early adventurers thither were of the same faith, as well as that outfitters being Calvinists would not admit Jesuits into their ships. Next, the two religions for a time there held divided empire. When a priest and a minister there died on the same day, they were laid in the same grave. "Let us see," it was said, "whether they who have always lived at war will now lie in peace." The first petition of Jesuits that "reformed religionists," so-called, should be forbidden to inhabit Canada dates from 1621. Rejected at that time by the French king it was granted six years afterwards.

Had such been the French foundations in our Northwest, they might still have stood strong there. The Canadians, while scarcely a tithe of the English, held their own for a century. What if they had surpassed them in numbers, as much as they did in unity, military spirit, and friendship for the aborigines?

In all likelihood France and England would to-day hold divided empire throughout the territory embraced by the United States. The settlers,— each race afraid of the other,— would both have clung to their mother countries, and sought protection under their wings. During the Napoleonic wars, instead of being developed by the carrying-trade of Europe,— by a market there for all our products, and by dedication to the arts of peace, we colonists should have been all the while belligerents,— and that between two fires, pierced by invasions from the west, while our coast was ravaged and our ports bombarded.

Not a few in this audience are of Huguenot descent. Their ancestors in all colonial wars must have fought against those British provinces for which in fact they fought.

Even if the colonies,— English and French,— had one or both of them become independent, each race would have forced the other to maintain a standing army of European proportions, to build a Chinese wall, or line of forts — "the labor of an age in piled stones," — from the Upper Lakes to the Gulf. Border collisions would daily occur. Wars must have been frequent and chronic.

Again, had the French centuries ago burst into the Northwest by thousands instead of by scores, they would have planted their mediæval institutions too deeply to be rooted out. Lords of broad domains would have monopolized the land. Under them would have been vassals uneducated save to drudgery or death-dealing, not one in a thousand of them rising above the low level of that inglorious throng in which they were born. The Texan question of a witness, "Do you write your name like a monk, or make your mark like a gentleman?" would have been common all the way from the tropic to the pole.

The masses would have remained clannish retainers of hereditary chiefs. Each seigniory would have been a section cut out of France with all the pre-revolutionary enormities carried over ocean and continent like the angel-borne holy house of Loretto, and set down in the Mississippi Valley with all its imperfections on its head.

Even that earthquake revolution which toppled to the earth the feudal fabrics of France, would not have extended into the heart of this continent. It was, in fact, powerless even on the lower St. Lawrence, so far as not reinforced by British thunder.

On the whole, had Huguenots been tolerated from the first in New France, a million of them would have migrated there, and its population would have been no less numerous or puissant than that of British America. All the European colonies in America would probably still be subject to their parent states.

At all events they would have so balanced each other, and their mutual relations would have been so antagonistic, that the rise, progress and world-wide influence of those institutions and that form of society which are distinctively American, would have been impossible. America would have been Europeanized. There is no room in the universe for both Christ and Belial. So there was no room in these United States for both freedom and feudalism.

Well then may we thank God for the intolerance of Louis

XIV, or rather for the passing-pleasing tongue of Madam Maintenon, which kept that *Grand Monarque* her unconscious servitor. Though he meant not so, neither did her heart think so, their policy was suicidal. They were pioneers clearing the ground for the undisturbed establishment and expansion of a system — political, religious, educational, social,— which was ordained by God, and utilized by man, for revolutionizing not only America, but France and Europe. May that system of ours pervade the world, endure forever, and prove a survival of the fittest!

In our northwest French and Indians have stamped their names forever on many natural features,— lakes, rivers, mountains, and on hamlets which have, or will, become cities. But, while names are French and Indian,— as Chicago and St. Louis,— all else,— all distinguishing characteristics bespeak the Anglo-Saxons. They came out from Great Britain in order to build on a broader basis a Britain yet greater, continental and cosmopolitan, gathering together in one those whom Babel scattered abroad. Hence it has come to pass, that in the world's wide mouth, we today are called, not New French, nor yet New English, nor by the name of any Europeans whatever, but *Americans*, now and forever Americans. That cognomen is already all our own, and this fact I hail as an omen that the continent also in all its length as well as breadth will be ours ere long;

"THE UNITY AND MARRIED CALM OF STATES."

APPENDIX.

The following notes and strictures on the preceding paper have been sent me by Benjamin Sulte, Esq., of Ottawa, Canada, who is in many respects the most learned investigator known to me in matters relating to the early French in Canada.

I am happy to supplement my own studies by his aid. Into whatever inaccuracies he shows me to have fallen, I am quite sure that his general views correspond with my own.

It will seem to some readers rather strange if no one of those early French had been a convict — so that New France was an Eden as free from serpents as Ireland was ever fancied to have been rendered by St. Patrick.

M. Sulte says:

Champlain visited himself all the parts of Canada he could reach, and sent all round — especially in the direction of the west — as many young men as he could engage in the enterprise, in order to have them rendered familiar with the language, the habits of the Indian4, and the geography of the country. These efforts of Champlain, from 1609 to 1634, are most remarkable. He really formed a class of men, usually called interpreters, which is quite different from the one you allude to (the *coureurs de bois)* and which stood alone with the Jesuits, on the broad field of discoveries up to 1660, when the other class *(coureurs de bois)* began to exist. Thus, you have put together two different periods quite distinct from one another.

Now, as regards Nicolet's enterprise towards the Wisconsin region. He simply acted under Champlain's orders in this case, the same as he had done since 1618. There can be no two explanations of the motive that determined his trip of 1634. Champlain in this was following his old plan of discovery and alliance with the Indian tribes.

I wish also to state that the settlers of New France were never chosen from amongst the convicts of old France. Not a solitary case of that nature can be proven. We have the most abundant archives and records on the subject of the origin of the French Canadians that any colony can show. From Louis Hebert, the first settler, who came in 1617, to 1700, when immigration thoroughly ceased, every man is recorded in full and the descendants of these settlers still contine to correspond with the branch of the family remaining in France. If convicts ever came, they must have been hired by the companies who had the monoply of the trade — but I don't believe merchants were ever so foolish as to do that. I defy any one to prove a single case of a convict brought to Canada to settle there. If you possess any document on the subject, be sure you have something new on hand,— because no such affirmation has yet been maintained with proper authority. It must also be borne in mind that the settlers, or *habitants*, or French Canadians, as they are called, formed a population separate from the classes engaged in the fur trade or any other trade. It is a great mistake to intermix their history. Settlers had nothing to do with anything else but settling the country; they are the *only* group of Frenchmen that have resisted all hostile influences up to now,— the others have long disappeared. It is true, the settlers' sons have often turned to be *coureurs de bois* and engages of the trading companies, but this was to the detriment of the habitant community, i. e., directly the contrary of what so many historians have said about this question. Far from being an ancient vagabond, the settler was *invariably* a farmer that came from France purposely to establish his family on a farm in Canada. Unfortunately, the recruiting of young men, afterwards, from the country places of Lower Canada, for the purpose of trading in the west, paralyzed the little colony to a great extent. M. Parkman, whose appreciations are so seldom correct, says that the colony (1685) was living on the trade carried on with the Indians! What a stupid idea! Such trade was really killing the colony. The fields were abandoned by the farmers' sons in the hope that they could make their fortunes in the woods. The monopoly destroyed the colony. The habitants never were in favor of it; they always complained of its results; but what could they do under the absolute and tyrannical system of Louis XIV. and the scandalous government of Louis XV.?

Did you ever put this question to yourself: What are the present French Canadians; where do they come from? Here is the whole question.

The French Canadians are purely and solely the group of farmers that came from 1617 to 1700, by small bands, under the direction of agents called seigneurs, but who were nothing more nor less than agents of colonization, and men of energy wishing to settle with their families in the new country. That group is distributed as follows:

4,000 men taken from farms in France.

1,000 men from regiment of Carignan Salière.

1,500 women that came with their husbands.

2,500 women selected by good authority and sent here to marry with settlers.

In all no more than 9,000 souls.

These people lived on their land and never meddled with the French group of officials, military men, public servants of all sorts, traders, etc. They formed the resident population. They alone remained in Canada. They are the French Canadians, whilst the others were mere Frenchmen. It is a general mistake of historians to confuse these two classes.

The settler, the habitant, the French Canadian, in brief never begged for help from France, except in the shape of troops (1637–1665) to chase the Iroquois, and in the shape of more settlers (1666–1688) to augment the colony. All the complaints in the Govenor General's letters mentioned by Mr. Parkman bear on those Frenchmen not settled in the country. Those were the begging class — the same class that ran away at the conquest (1760) to find a refuge in France. The settlers never regretted them! This accounts for the facility which the English enjoyed during the first ten years (1760–70) in the administration of the country.

Allow me to observe, also, that Champlain had only three men with him when he ascended the river Ottawa in 1613.

You seem to have no conception at all of what was the Canadian feudal system. The paragraph (page 55) in which you make allusion to it is so completely out of the real facts that I cannot but think that you have read Parkman, who is full of such efforts of imagination. It is true that English writers are always copying each other when they speak of Canada of old. The only sources of history for the period in question are written in French; then study them in the original, and not in the books of fanciful writers who have probably never completed the study of the proper documents. Does any English writer know that the French-Canadians possess 500 volumes about their own history, besides the enormous manuscript archives at their disposal? Mr. Parkman is clever enough to make his readers think he discovered the documents he mentions, but the truth is that he merely ran his fingers through the 500 volumes in question — half of the time copying full pages of them without giving credit to the author.

I am not astonished at that. The province of Ontario, close to that of Quebec, is not at all enlightened about the French race in Canada. Newspapers and books are published there every day that are a repetition of falsehoods destroyed fifty times within a century. I was reading last week an article about "ignorance concerning the French-Canadians," published twenty miles only from the French province. No wonder that the Americans, who are located still further from us, are so completely informed on our subjects.

Speaking of the northwest, you mention our establishments here. The fact is that the French trading company had fur trading houses from 1721 to 1753 in that direction; they withdrew their men at the time of the conquest (1760). Those that remained there were partly Frenchmen of France, partly French-Canadian coureurs de bois. From 1760 to 1783 they lived with the Indians. In 1783 the "northwest" company was founded, and these men got hired by them for the trade. The first four white women who were sent to the Red River with their husbands, about 1810, saw no cultivation there. I don't see that we could speak about a colony which never existed. The only French colony worth looking at was the one established between Quebec and Montreal — and that one is still in existence. All the rest is a matter of trade, discoveries, missions, etc., quite distinct from the agricultural colony.

For want of light on the ensemble of the question — *all* the English writers resort to their imaginative power to explain what has taken place amongst us in the past,— and strange to say they don't even understand the present time

Coming back to Nicolet, I must not forget to tell you that in 1634, there were hardly one hundred people in the colony — all told, counting Frenchmen of all sorts possible. Out of that number, we have the names of Nicolet. Margry, Godefrey, Hertel, Marsolet, Brulé, and two or three others, who were interpreters. Seven or eight others were employes of the trading company called the Hundred Partners. Real, actual, true settlers were altogether about forty souls — say 7 or 8 families.

The *Feudal System* of Canada was practically a mechanism for colonization and it worked to the satisfaction of all parties interested. It lasted in full force from 1627 to 1854, without creating any conflict of importance. Its spirit so admirably adapted to the circumstances of the country and the necessities of the times, especially from 1626 to about 1700, is not understood by English-speaking writers generally, but here, in Canada, we know better.

A *seigneurie*, measuring six miles in front by six or twelve in depth, was granted to any man willing to bring settlers from France at his own expense, and provide them during a reasonable time with the requirements of their new situation. These seigneurs were all, with very few exceptions, men of pretty good family, but none of any high position, except now and then one like Bishop Laval, who resided here and could superintend affairs through an employe engaged for that purpose.

In round figures, 159 of those seigneurs obtained lands between 1626 and 1760. Five or six of them were high officials in the colony; seven or eight officers discharged from their regiments — the rest (130 or more) men who did not rank with the noblesse in France and who looked to Canada as a country where they could build a future for themselves. I wonder at the imagination of Mr. Parkman when he speaks of the Canadian seigneur fresh from the court of Paris or Versailles! I wish he would name those who ever met with the splendor of "le roi-soleil!"

These men were full of courage and the spirit of enterprise. The very fact of trying to make a living in Canada and to rise to a higher situation here than in their mother country, speaks loud in their favor.

They were under obligation to establish settlers on their seigneuries at a certain rate per annum. For this purpose, they recruited in the villages where they were best known in France, young farmers with their wives and thus formed in each seigneurie a fac-simile of the group left at home. From 1626 to 1662, each seigneurie was governed after the particular code of law (coutume) adopted in the part of France which they came from. In 1664, the *Coutume de Paris* was extended over all the colony. Each settler was given a lot measuring three or four acres[1] in front by forty deep. In this manner the road from Quebec to Montreal was quickly open for use in all seasons — because the narrowness of the land made the houses close to each other, and instead of having a village — a continuous street of 180 miles in length was obtained. The king remonstrated against this arrangement — he was in favor of villages — but the "habitans" never listened to his objections. They knew better.

The seigneur was the first amongst the pioneers, the first to attack the forest the first in the field with the plow. After three years, a settler needed no more assistance. From that moment, he was able to pay his "redevance" to the seigneur. His taxes were partly in money, but more often "en nature" — the whole amounted to about $7 or $10 per annum, — all included, except what he had to give the miller when using the mill belonging to the seigneur — namely, the 26th part of the flour produced. A seigneur who was the recipient of $2,000 was a wonderfully rich man. Most of them never received more than $700 or $800 per annum.

They were representatives of the people as their seigneurs at Quebec and elsewhere when required. Their interest was so closely connected with the welfare of their retainers that no better system of "deputation" can be conceived, and mark that the laws concerning the administration of seigneur's were not in the hands of the seigneurs. Far from that, these laws were greatly in favor of the tenants. The consequence is that the seigneurs very seldom got the better in their contests with the farmers. These laws, interpreted from time to time by the King's ministers, always ran this way: In the beginning the seigneur is a father to his clansmen, because he and they

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[1] By acres *arpents* each of 180 French feet are probably meant. J. D. B.

left France together after a long acquaintance, to seek a home in Canada. But the sons of the seigneurs might turn to be of a different stamp, and we must have a check on them.

When a tenant wished to have a lot for himself or his sons, he could select it, and the seigneur had no power to prevent it, nor to tax the lot more than the usual rate.

The administration of justice was a simple affair. The judge of the seigneurie was appointed by the seigneur, subject to the approval of the Governor General, and as the habitants had free access to this high official though their "syndics" and "capitaines de milice," every party was consulted before action was taken."

When the judge of the seigneurie had rendered a judgment, there was an appeal to the Justice of the Province in which the seigneurie was situated, *i. e.* Quebec, Three Rivers, or Montreal — and from there to the *Conseil Souverain* of Quebec, presided over by the Governor General. You can see that the seigneur had only the "basse" justice, and that that even was subject to appeal. As for "moyenne" and "haute" justice, although some seigneurs can show the words in their parchments, it was never exercised by them.

The seigneur was not necessarily a warrior, as Mr. Parkman so pompously describes him. Most of the seigneurs never troubled themselves with war. The militia organization was a separate affair. Some seigneurs' sons did mix themselves with the militia, but all they knew of military science was picked up in hunting on the paternal domain. That class of men became an annoyance after 1675 or thereabouts. They threw themselves into the woods and became the famous *coureurs de bois* or outlaws. They led other young men — sons of habitants — into that dissipated life.

By the time when settlers ceased to arrive from France (say 1690) the above vagabonds were a subject of much displeasure in the seigneuries — and most of the seigneurs had become very poor, owing to the inconsistency of the administrators of the colony who had brought the whole of the inhabitants under the thumb of the mercantile companies. Then the seigneurial power began to die, because the country passed virtually under the officials, traders and the like who had no other ambition than to make money and oppress the colony for that object.

In brief, the feudal system of Canada was so much liked that nobody thought of asking for its abolition before 1853, when Upper Canada agitated the question. Even now, it exists in many parts of the Province of Quebec, because it is useful there to this day for the purpose of colonization.

If the English House of Commons had not rejected the petition of the twenty counties in the eastern townships peopled entirely by English and Scotch emigrants, who, as late as 1828, wanted to adopt the French Canadian feudal system, these counties would have remained English. In fact, they have been conquered by the French-Canadians whose system of land tenure is far better than the English for a country like Canada, still sparsely settled.

THE PHLOSOPHY OF F. H. JACOBI.

BY PROF. W. C. SAWYER.

Nothing is quite so real to an animal as the food he eats and the bed he sleeps upon. We are all animals and something more, but there is a popular tendency among us to cherish the grossness of the animal, and to smother and starve the heaven-born part that struggles for recognition through perceptions more ethereal than the animal knows, and longings that the animal cannot feel and that material things can never satisfy.

Assured that the meat by which man really grows is not that which nourishes the body, we do well to sit at the feet of those masters who offer to guide us out of this thralldom to the physical, and open our eyes upon the less palpable, but no less real, world in the midst of which we so unconsciously walk; for

> "The spirit world is not locked up;
> Thy feelings are closed, thy heart is dead."
> —GŒTHE'S FAUST.

F. H. Jacobi has the distinguished merit of establishing against Kant the following point: The "Critique of Pure Reason" denies that any casual nexus can be found between thinking and any noumenal object or subject, while the "Critique of Practical Reason," ignoring the principle already laid down, boldly assumes the transcendental as revealed by the phenomenal. Kant attempted to find some impossible demonstration for that which is undeniable and needs none, and thus threw a character of uncertainty upon the most positive knowledge that we have.

The work entitled "Divine Things and Their Revelation," was Jacobi's last, and probably contains the best exposition of his distinguishing doctrines, especially his "faith-philosophy." For this philosophy its author never claimed a place beside other systems, but, [perhaps even too hastily and modestly, granted the argument to philosophers whose conclusions were revolting to him, but whose methods seemed to him valid. He thus occupied an anomalous position, which must be explained in one of these two ways, namely, either Jacobi was in error in supposing that the head positively demanded pantheism and the heart Christianity, or we are constituted with a cruel and irreconcilable antinomy, waging perpetual war in the center of our being, and setting one member against another in a manner for which no development theory can account, and of which no beneficent Creator could be guilty. This is the most important error of which Jacobi can be convicted, as he himself clearly saw. He was fully aware that his doctrines must break into two opposed systems, one of which must be false, by the most positive principles of logical opposition.

An antinomy may well lie under the suspicion of being nothing more than a convenient name under which to cover the shortsightedness of men. Can God's laws conflict? or can it really be that both the affirmative and negative of any given proposition can be supported with equally strong proofs. By any given man, perhaps they may. In a boys' debating club they often are; but even the boys usually think that, if they knew all, the scale would promptly turn to one side or the other. With what reason, then, do men talk of antinomies as soon as the *pros* and *cons* seem to balance? It is clear that the data upon which rests one of the conflicting judgments must be either inaccurate or inadequate, unless there is a fallacy in the logic.

A supposed conflict of laws is sometimes attributed to the error of applying reason to matters beyond its sphere, as though there were spheres where reason could mislead, or where it were better, forsooth, to be unreasonable. Both Locke, in his "Essay Concerning the Human Understanding," and Kant, in his "Critique of Pure Reason," have given expression to views of which this would be a bald, but perhaps not altogether unfair, statement. Not the excess, but the deficiency, of reason leads to error; and laws which really conflict must be human. The Creator of the macrocosm created also the microcosm, and "I doubt not through the ages one increasing purpose runs." Rob the world of the faith that all things fit into the harmonious plan of the Author of all, and the philosophy of history, and the grand system of correlated sciences, which thrill us with enthusiastic delight as they unfold before us, would, like bright dreams or punctured bubbles, vanish from the earth. All forms of matter, and all the faculties of the mind, must be supposed to be governed by harmonious laws, and enter, as co-ordinate elements, into the plan of the universe; else we impeach either the power, wisdom, or goodness of God.

Jacobi's philosophical creed developed at a time when the prevailing philosophy was Kant's, with all the admiration that belonged to its freshest triumphs. No other theme was so prominent as that to which, a century earlier, Locke had drawn very general attention — the question of the powers and limitations of the human understanding. After making experience the basis of all our knowledge, Locke was so unfortunate in his explanation of the origin of our ideas that Cousin easily convicted him of laying an excellent foundation for that sensationalism for which Hobbes and Condillac acknowledged their indebtedness to him, however distasteful such thanks might be.

It may not seem unnatural that Hobbes should derive from Locke's representative theory of perception his subtile corporeal spirit to replace the second member of Descartes' dualism, but it is far more startling to find Bishop Berkeley, with "every virtue under heaven," establishing upon the same basis a thorough-going idealism, and successfully maintaining his ground against the whole sensational school. To exhaust the strange possibilities of the case, Hume, again, accepting both Locke and Berkeley, advanced one fatal but inevitable step further, and, consigning mind to the same fate that matter had suffered at the hands of Berkeley, established a skeptical nihilism, which no subsequent philosopher has been able to refute without revising the whole foundation of the system upon which it rested. This task called for the genius of a Kant. He was able to reconstruct the principles of knowledge upon the ruins to which Locke's system had been reduced by the twofold *reductio ad absurdum* of Berkeley and Hume. In doing so, however, though he gained the foremost place among the metaphysicians of his age, he committed an error hardly inferior to Locke's, and quite as difficult to throw off. Locke perceived only images of things, that, so far as he could show, might have no corresponding external objects behind them. Kant, on the other hand, perceived only phenomena, and knew nothing of the things in themselves, which are manifest only in the phenomena. For both alike objects were implied as the originals of the images of the one, and as the principals behind the phenomena of the other. Both alike have furnished a basis upon which logical minds have built up systems that have violated the plainest dicta of common sense. Every body but a few philosophers thinks he knows that he walks in an actual physical world, and among other men like himself, while, according to Locke and Kant, pure reason teaches nothing of the sort; but rather that the world which we see is within us, and that we may be dreaming as truly in our waking as in our sleeping hours. Goethe appreciates this situation very well when he makes Faust say that this philosophy leaves him "as great a fool as he was before;" and then, in despair of knowing anything, turn to the sensual enjoyments of the world.

From the particular error of Locke philosophy has largely, but not altogether, recovered; and from Kant's it is slowly recovering. To this end Jacobi has contributed the earliest and best assistance, by showing that sensation testifies not more positively of the so-called secondary qualities of bodies than of their objective actuality, as will be more fully shown in the proper connection.

But Fichte contributed toward the correction of Kant's error in a way similar to that in which Berkeley had exposed the weakness of Locke. Fichte inquired whether it was true that an actual objective world caused the subjective phenomena, as Kant evidently assumed. In his investigation of this problem he found in his consciousness the sensation, and from these inferred the objective, not in the relation of cause, but as the effect or product of the active mind. He accordingly gave a confident negative to his own query, and adopted the full consequence of the error in the central doctrine of his philosophy — that "all cognition is a self-activity which perceives only its own self-activity."

When Schelling replied to Fichte's reasoning, that we might with equal propriety reverse his process, and suppose the subjective to result from the objective, then the claims of both to priority were recognized as equal; and both Fichte, in his latter days, and Schelling, admitted that an absolute existence underlies all phenomena.

A very important further modification of the philosophy of knowledge was achieved by Hegel, and still attracts great attention. He united the subjective and the objective into such a union that the latter was implied in the former. The phenomena which we perceive were regarded as having the same character objectively as subjectively. "The ground of their being," said Hegel, "is not an unknown essence immediately behind the phenomena, but the absolute idea." Thus constituted, absolute idealism makes a radical contrast with the subjective idealism of Fichte.

This system of Hegel, first offered for publicatfon in Jena, during the bombardment of that city by Napoleon, is a little later in its origin than the faith philosophy of Jacobi; nevertheless, Jacobi is, in a certain sense, the representative of an elementary form of the latest philosophic thought. What the philosophy of the future is to be, no man can confidently tell; but it may not be too bold to predict that what Jacobi felt, but dared not say he knew, will yet find many to recognize its philosophical validity.

The chief claim of Jacobi to recognition among philosophers rests upon his doctrine that we have a direct intuitive knowledge of the suprasensible — that we see it with the "reason" as truly as we see physical objects with the eye. This doctrine has usually been regarded as enthusiastic, and its author sometimes set down among the Mystics of Germany. The degree of reproach implied in the terms *enthusiastic* and *mystic* varies with the persons who use them. When enthusiam is charged as equivalent to fanaticism, and mysticism as implying obscurity and error, they simply beg the question at issue. A legitimate enthusiasm is what Jacobi claimed; and if we translate the Greek elements of the word (ἐν θεός) as "God within," the meaning is rescued from all implication of error. Fanaticism is as far from the best sense of enthusiasm as rage from anger — to borrow a simile from Voltaire.

The quest of philosophy has ever been, before all else, for the efficient cause of nature. This cause does not appear in the nebular hypothesis, or in the atomic theory; for science cannot account for the first movements of either. Locke did not find it, for he had no secure hold upon anything objective. Kant did not find it in the pure reason, for pure reason could know nothing of any thing in itself. Jacobi found a first cause, he was sure, but only in his heart — there was not quite room enough for it in his head. He claimed that this, together with some other knowledge, is impressed upon the soul without the intervention, in any way, of physical organs. The philosophy of Locke does not willingly admit any impressions upon the *tabula rasa* of the mind apart from the products of sensation and their combinations. Jacobi's claims must, accordingly, be positively refused, or some of the principles abandoned which have been maintained, or tacitly admitted, by a multitude of philosophers. The *tabula-rasa* simile has been convicted of fault in the implication that the mind is a cold and dead slate, that simply holds, without addition or change, whatever is committed to it. If this were so, there would be for us no external world — all primary qualities of matter would be forever shut out of the mind, for no sensation ever resembled any one of them. Secondary qualities are purely subjective. They not only do not resemble in the least their immediate physical causes, but even these do not reside in the bodies to which we refer the qualities as by instinct, while the inferred concause, which *is* in the body, is beyond the reach of our investigation. It must be, then, that we are indebted to certain original energies of the mind for all that we know of the external world, even after sensation has revealed all that in the nature of the case is possible,

Kant insists upon the testimony of sensation as essential to the validity of mental products. Jacobi insists that he sees a light, which to the physical eye is invisible. Is he mistaken? or is Kant's requirement unessential?

A sensation is a feeling awakened in the mind through the medium of an organ of sense. This sensation becomes a perception when referred to the external object which occasioned it; thus do we acquire all our knowledge of the outward world. What, then, are the essential elements in the formation of any perception? Before all, something must be impressed upon the consciousness. Sensations depend solely upon the nerves to convey them to the conscious subject. Any interruption of their career toward the brain puts an end to them, or rather, there being no sensation in the consciousness, none exists anywhere. If, therefore, sensation is essential to perception, then nerves are likewise essential. But nerves are only the menial organ which serves mysteriously to convey impressions to the mind, without, in ordinary perceptions, revealing themselves to the consciousness. Some perceptions, moreover, such as the perception of relations, are generally recognized as being independent of all sensation. So, too, causation, time, and identity, must be perceived, if at all, without the help of any mechanism, since in their nature they are impalpable. No particular character in the object, therefore, can be pronounced essential to mental perception; immaterial principles are perceived as clearly as granite hills.

It thus appears that the practical objective conditions which now limit perception may be purely casual. Only two elements remain which can be shown to be essential in the perception of all things objective. These are feeling and reflection; feeling, because it is the condition of both sensation and consciousness, and whatever is not felt in either of these ways cannot in any manner make itself known; and reflection, because feeling is not thought, and no knowledge can result from feeling simply as feeling, any more than we can become cognizant of a present physical object without looking upon it to discover its qualities. Reflection interprets feeling into terms of thought. This is done spontaneously, to be sure, and seems to attend rather than follow the feeling — what obviously follows being inference rather than intuition.

Both these essential conditions being met, the source or cause of the feeling does not affect the validity of the consequent perception. The feeling itself is sufficient evidence of the *actuality* of its cause; its *nature* is a distinct problem. "Whoever says he knows," observes Jacobi, "we properly ask him whence he knows. He must then depend at last upon one of these two things, either upon sensation or upon soul-feeling." All knowledge resting on the latter Jacobi denominated "faith," and he doubtless enjoyed the same assurance of his "faith" as of his material possessions. Yet it was Jacobi who cast upon this assurance the reproach of being unphilosophical. That reproach commends the modesty of the philosopher more than his logical powers. It must be set down as his weakness that he dared not maintain as legitimate the firmest convictions of his soul, simply because the method by which he reached them was not philosophically orthodox in his day.

The best use of philosophy is, doubtless, to regulate human conduct; and that which is unphilosophical should accordingly be abandoned. Why not, then, abandon every thing which is given us by the intuition of reason and from no better source? Why not give up the notion of an external world? Simply because the universal conviction of the race makes it impossible. Men do not wait for the formal decisions of philosophers upon questions which find uniform answers in their own clearest intuitions. No contradiction of this decision would command their respect. Again, why not abandon the notion of a First Cause presiding over the universe and governing it according to the intelligent determinations of an unrestrained volition? The answer is to the same effect as the former, Because all races and tribes under the sun hold some faith in a god to whom they are responsible and expect to give account. The argument from common consent must not be despised. Philosophy cannot ignore it without itself being rejected. It rests upon intuitions which are universal and necessary, and which no authority is competent to gainsay.

Jacobi allows a logical validity to the pantheism of Spinoza, but it affords no satisfaction to the desires of his soul. His spirit rejects pantheism, while his reason accepts the demonstration on which it rests. His spirit, on the one hand, clings to the "faith," which his understanding cannot approve. Fully conscious of this paradox, Jacobi declared, "There is light in my heart, but when I attempt to bring it into my understanding, it goes out." What loyalty to the conclusions of a syllogism built upon false premises and doing violence to the strongest and purest intuitions of the soul! A weaker "faith" would have surrendered to so strong a conviction of the demands of the understanding. A stronger logical faculty would have scorned the ambiguous position which Jacobi under protest occupied. It may not be evident which was the weaker, his "faith" or his reason, but his preference between the horns of his dilemma was unmistakable and strong. The sphere of the simple understanding he plainly calls inferior, since it sadly disappoints the highest aspirations of which we are capable. These are satisfied in the intuitions of the divine, in which Jacobi realizes the highest of all possible objective revelations. To rescue these intuitions from the fatal monism of Spinoza, Jacobi deliberately sacrificed his philosophy, such as it was, in favor of his faith. From that moment he formed a marked contrast with Spinoza. The latter knew no personal God; Jacobi ever felt his presence and heard his voice. Spinoza knew no causes except as immanent in matter and necessary; Jacobi recognized a Final Cause, and was conscious of his own freedom, and of his own accountability. Spinoza consequently enjoys a passionless repose, fearing nothing and hoping nothing, and witnessing the dissolution of his body with a stolid resignation, regarding his decay as another proof of his brotherhood with the clod. Jacobi, however, quick with the pulsations of an endless life, stretching eagerly forward to catch glimpses of the dawning of the bright to-morrow of his soul's desire, is by no means satisfied with the realizations of this life, but is more than satisfied with its hopes.

With Fichte and his ideal projection of subjective images Jacobi felt considerable sympathy. Fichte's soul was quick to recognize the spiritual forces of the universe, but he did not perceive their objective character. At this point Jacobi resists again an apparently valid conclusion in the clear light of his own intuitions. He was sure he saw, in the moral order of the world, a Father's hand; Fichte saw only a reflection of his own volitional activity. Such intolerable consequences of the reasoning of his metaphysical contemporaries, Jacobi escaped by resorting to the oracles of a higher authority. "There dwells within us," he said, "a spirit sent immediately from God, constituting the most essential part of our human nature. As this spirit is present to man in his highest, deepest, and most personal consciousness, so the Giver of this spirit, God himself, is present to man through his heart just as nature is present to him through his senses. No sensible object can so seize upon the mind and irresistibly prove itself real, as those absolute objects, the true, the good, the beautiful, and the sublime, which can be seen with the eye of the spirit. We venture the bold speech that we believe in God because we see him, although he cannot be seen with the eye of this body." This spiritual vision is quite as clear as the physical; it is attended with no less feeling immediately produced in the soul, than comes to the soul through the office of the outward eye. It is not the eye that sees, but the soul by means of the eye. Such seeing is mediate, while Jacobi, if he sees God at all, must see him immediately, with no Moses and no organ of sense to stand between. Actual perception is not denied to sensation when it is referred to its cause. Who shall dispute that this intuition of an invisible Deity possesses at least as high claims to the character of a real perception as the sensations, exposed as they are to the defects of the physical body? May not the intuition even have some advantage, in the certainty of the objective existence over mediate knowledge, at least to the subject of it?

Sir William Hamilton maintains that in intuition cognition is given unconditionally as a fact, while, in all representative perception, the cognition is problematical. Should it be objected that Hamilton assumed, in the intuition of which he speaks, that the mind is conscious of only its own modification without relation to any object beyond the sphere of consciousness, it ought to be sufficient to show that Jacobi's claims find ample room for realization under the careful definitions of this most astute philosopher. We do not understand Jacobi to claim that his intuitions reach to a cause, which, as perceived, is outside of himself, but rather that this knowledge is simple, and contains in it, as Hamilton himself says, "nothing beyond the mere consciousness, by that which knows, of that which is known." This consciousness of necessity cannot reach out and take hold of the external; but if the external be spiritual in its nature, as it cannot impress itself upon any physical sense, so no physical barrier can obstruct its approach to the center of thought and feeling. Accordingly, Jacobi can say that "God himself is present to man in the heart," and that the human spirit contains "a shadow of the divine knowledge and will."

In this light we can understand our philosopher's meaning when he maintains that man reveals God, while nature conceals him:

"But is it unreasonable to confess that we believe in God, not by reason of the nature which conceals him, but by reason of the supernatural in man, which alone reveals and proves him to exist? *Nature conceals God;* for through her whole domain nature reveals only fate, only an indissoluble chain of mere efficient causes without beginning and without end, excluding with equal necessity both providence and chance. . . . *Man reveals God;* for man, by his intelligence, rises above nature, and in virtue of this intelligence is conscious of himself as a power not only independent of but opposed to nature, and capable of resisting, conquering and controlling her. As man has a living faith in this power, superior to nature, which dwells in him; so has he a belief in God, a feeling, an experience of his existence."

This doctrine is perfectly consistent, as Jacobi claims, with the criticism of Kant, though it cannot be harmonized with the doctrines of Spinoza. Indeed, Kant's demonstration that the pure reason finds no certainty in practical things, not only admitted but even called for Jacobi's doctrine of a direct intuitive cognition of things-in-themselves. This intuition tramples upon the mechanism theory of the universe, and, rising above the defects of demonstration, gazes boldly upon the revealed face of the one great Cause that reason had long ago declared to be immanent in all forms of being and becoming.

This noblest function of the soul Jacobi did not uniformly denominate "faith," especially in his later writings. This term was too liable to be understood to imply a blind, irrational belief on the mere authority of others. To avoid so great a misconception of his doctrine Jacobi used the term "reason" *(Vernunft)*, meaning, not the logical faculty, but the power to perceive directly in contrast with the understanding which is confined to the range of the demonstrable. The term "faith," therefore, when used by Jacobi, implied the surest possible kind of knowledge, but a knowledge which in its very nature cannot be communicated to another by a syllogistic method. This is why the light in the heart was quenched when brought into the understanding. That light conveyed the divine image, which in the order of nature must be felt in order to be known. We cannot always describe what we have seen with our natural vision; much less can we expect to impart to another the first fruits of our spiritual seeing. The Apostle Paul said it was not lawful to utter the things which were revealed to him when "caught up into paradise." Similarly, doubtless, it is unlawful — *impossible* on account of the dis abilities of our nature — for a man to formulate and communicate to another all of the religious experiences of his heart, even after they have so entered into his being that torture and death cannot induce him to deny them. This is the philosophy of the believer's testimony, daily declared in the sanctuary and daily disputed in the mart, "I *know* that my Redeemer liveth."

Owing to a lack of this experience the unbelieving naturally question the legitimateness of this faith, or at least ask the believer to prove a necessary connection between the mental phenomena on which he rests his faith and any objective cause. Suppose we make a similar demand of themselves. Can they show any necessary connection between the best established facts in science and any objective cause? All knowledge hangs upon a chain, some links of which are hidden, so that, without the exercise of a large practical faith, no science would be possible. When we trace the phenomena involved in a single perception of an outward object through the eye, we are charmed with the delicate offices of different parts of that organ; but when the light, in obedience to optical laws, has painted a beautiful inverted image of the object on the fine tissue of the retina, the physical phenomena of vision can be traced no further; they cease or disappear as motion, or physical change, and re-appear at once as intellectual perception — something which bears no discoverable resemblance to any of the physical phenomena of seeing. The chain of causes in all perceptions goes out of sight, some links are hidden.

According to Lotze,[1] "We shall never be able to prove that it

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[1] Mikrokosmus, vol. i., p. 161; Leipzig. 1856.

lies in the nature of any motion . . . of itself to cease as motion and be reproduced as illuminating brilliancy, as sound, or as sweetness of taste." The motion here referred to is the sensible or physical part of the phenomena of sensation. The causal nexus between a wave, whether in the eye or in the air, and the mental conception of light, no man has ever discovered, but the scientist and the philosopher alike, together with universal humanity, accept with a practical assurance that cannot be shaken the testimony of their consciousness to the objective reality of the things perceived through any organ of sense. In unscientific terms, then, we may say that we know the things within reach of our senses because we *feel* them.

Feeling is the function of all the afferent nerves, and in some mysterious way we hear, taste, see, etc., by feeling. All the mechanism of our organs of sense is necessary to bring the physical within the grasp of the spiritual. By the aid of this mechanism we feel, as science insists, not the object, but some quality of the object appropriate to the sense in exercise. The universal consciousness, however, will have it that we feel *a body* thus and thus conditioned or qualified. Science says we feel the broad waves of light, or, practically, the redness of a physical body. Consciousness maintains that we see a *red body*. It is hazardous to quarrel with universal consciousness. Moreover, it would be unreasonable to reject, concerning the character of the phenomena, the testimony of the only authority by which its actuality had been, or could be, established. We *dare* not, therefore, banish the physical universe from our philosophy; we *cannot* banish it from our consciousness. God himself, in fashioning us so that we are thus compelled to recognize in our daily lives an objective universe, has involved his own veracity in the validity of these intuitions of our consciousness.

If we admit, as we seem forced to, that mind and matter can communicate, while their natures are so very unlike, much less should it be thought incredible that mind should be able to convey thought to another mind of the same nature. No mechanism can simplify or explain the perception of the physical; it simply makes it mysteriously possible. The same intuitional power that magically reveals to us a physical universe and enforces its acceptance may similarly discover the Cause of the universe and enforce a belief in that Cause. This it does, and no human race is known that has not some notion of God.

Clearer and more full than this universal faith are the direct revelations to the spiritually minded, who, like Socrates and Jacobi, seem to have found a shorter way to the knowledge of God than through the regularly accredited prophets. This personal inspiration seems to resemble, in the strength of the conviction which it carries, that instinct which Kant has denominated "the voice of God." Brute instinct is concerned with nothing but what is essential to the well-being of the species. All this it fails not to supply. Birds know how to build nests, but they do not know how they know, or what principles require them to build as they do. Men no more about the instincts that supplement reason in their own species. God supplies whatever is out of reach that is essential to any of his creatures. In endowing man with a soul God fixed upon him another necessity quite as urgent as the preservation of his body, namely, the preservation of his soul. The Creator is, then, under an equal, or still greater, obligation to supply whatever is demanded by the interests of our spiritual nature. It is not unreasonable, therefore, that we should listen for the voice of God in a new revelation. Jacobi and millions more say they hear it. They find revealed in it the Almighty and an endless life. They *touch*, as it were, the suprasensible, and *know* it by a sort of spiritual empiricism. They are profoundly convinced. The demonstrations of the spirit are irresistible, but if denied, they can no more be forced upon a skeptic than the axioms of geometry.

We cannot too highly applaud the opinion of Victor Cousin, that "the error of Jacobi's school was not to see that this truth-speaking enthusiasm is only a purer and higher application of reason, in such manner that faith has its root in reason." This "enthusiasm," in the mouth of Cousin, suggests no reproach, but rather implies a reason which flies while the syllogism creeps. It must be conceded also that this slower method is, by its very nature, debarred from ever demonstrating the infinite, and thus solving the most essential problems of religion and philosophy; for by the syllogism we can advance to no conclusion except through a more general conception. The term which must thus be included under another cannot contain the Deity, or satisfy the conditions of monotheism. The Highest, therefore, cannot possibly be reached through formal reasoning, and some other resource must be depended upon for this necessity of the soul. Nothing but Jacobi's intuitive cognition can yield the personal apocalypse of God.

When the clear testimony of consciousness is universally recognized as valid, then not only will Jacobi command an unqualified respect among philosophers; but objective science, as well as religion, will find a rational foundation, and, according to the claim of Drobisch, we shall realize in the philosophy of religion "the key-stone of the philosophical arch."

THE "Απαξ Λεγόμενα IN SHAKSPERE.

Omnia rara præclara; ipsa raritate rariora.

BY JAMES DAVIE BUTLER, LL. D.

When we examine the vocabulary of Shakspere what first strikes us is its copiousness. His characters are countless, and each one speaks his own dialect. His little fishes never talk like whales, nor do his whales talk like little fishes. This impression of mine grows stronger when I read in the Encyclopedia Britannica; "the language assigned to each character is made suitable to it, and to no other, and this with a truth and naturalness which the readers and spectators of every following age have recognized." Those curious in such matters have espied in his works quotations from seven foreign tongues, and those from Latin alone amount to one hundred and thirty-two.

Our first impression that the Shaksperian variety of words is multitudinous is confirmed by statistics. The titles in Mrs. Cowden Clarke's Shaksperian Concordance, counted one by one by a friend have been ascertained to be more than twenty-four thousand. The total vocabulary of Milton's poetical remains is more nearly seventeen than eighteen thousand (17,377); and that of Homer including the hymns as well as both Iliad and Odyssey is scarcely nine thousand. Five thousand eight hundred and sixty words exhaust the vocabulary of Dante's Divina Commedia. In the English Bible the different words are reckoned by Mr. G. P. Marsh in his lectures on the English language, at rather fewer than six thousand. Renan's estimate is 5,642. The number of titles, however, in Cruden's Concordance has been found to be greater by more than a thousand, namely 7,209. Those in Robinson's lexicon of the Greek Testament I have learned by actual count to be about five thousand five hundred.

Some German writers on Greek grammar believe they could teach Plato and Demosthenes useful lessons concerning Greek moods and tenses, even as the ancient Athenians, according to the fable of Phaedrus, undertook to prove that a pig did not know how to squeal so well as they did. However this may be, any one of us to-day, thanks to the Concordance of Mrs. Clarke, and the Lexicon of Alexander Schmidt, may know much concerning Shakspere's use of language which Shakspere himself could not have known. One particular as to which he must have been ignorant, while we may have knowledge, is regarding his employment of *Ἅπαξ λεγόμενα.*

The phrase *Ἅπαξ λεγόμενα*, literally "once spoken," may be traced back to the Alexandrine glossographers centuries before our era, who invented it to describe those words which they observed to occur once, and only once, in any author or literature. It is so convenient an expression for statistical commentators on the Bible, and on the classics as well, that they will not willingly let it die. The synonomous phrase *Ἅπαξ εἰρημένα* is also a favorite with some Germans, but if we accent it according to its Greek accents, it is hard to pronounce, and I accordingly eschew it. So does Autenrieth in his Homeric dictionary.

Style is modified by the presence of such words — a moment bright, then gone forever. Greek critics were early sensitive to this subtle influence on style and therefore catalogued those words which produced it.

The list of *Ἅπαξ λεγόμενα*,— or words used once, and only once, in Shakspere, is surprisingly large. Those words are more than any man can easily number. Nevertheless I have counted those beginning with two letters. The result is that the *Ἅπαξ λεγόμενα* with initial A are 364, and those with initial M are 310.

I have no reason to suppose the census with these initials to be proportionally greater than that with other letters. If it is not, then the Shaksperian words occurring only once cannot be fewer than 5,000, and they are probably a still greater legion.

The number I have culled from 146 pages of Schmidt is 674. At this rate the total on the 1,409 pages of the entire lexicon would foot up 6,504. It is possible then that Shakspere discarded, after once trying them, more different words than fill and enrich the whole English Bible. The old grammarians said their term *supine* was so named because it was very seldom employed, and therefore was almost always lying on its *back*. The supines of Shakspere outnumbered the employes of most authors.

No notices of Shaksperian *"Απαξ λεγόμενα* had come to my knowledge when my attention was first called to that theme. In the midst of my investigation, however, I observed a statement in the London Academy (No. 402, p. 48) that some English scholar had counted no less than 549 words in the single play of Henry V. that are no where else discoverable in the Shaksperian dramas. It may also be worth noting that the first line which Shakspere ever wrote, or at least published, namely:

"Even as the sun with *purple-colored* face,"

contains a compound which he thenceforth and forever refrained from repeating.

The multitude of Shaksperian *"Απαξ λεγόμενα* appears still more surprising if we compare it with expressions of the same class in the Scriptures and in Homer.

In the English Bible the *"Απαξ λεγόμενα* with the initials A 69 and M 63 are in all one hundred and thirty-two, to 674 under the same initials in Shakspere. These Biblical terms would be more than twice as many as we find them if as numerous in proportion to their total vocabulary as his are.

The Homeric *"Απαξ λεγόμενα* with initial M are 78. But if as numerous in proportion to Homer's whole world of words as Shakspere's are, they would run up to 186; that is, to more than twice as many as their actual number.

In the *Greek* New Testament I have counted sixty-three *"Απαξ λεγόμενα* commencing with the letter M, a larger number than you would expect, for it is as large as that in the whole English Bible commencing with the same letter, which is also exactly sixty-three. This fact indicates in Paul and others who wrote the Greek Testament a wider range of expression thna their English translators could boast.

The Shaksperian *"Απαξ λεγόμενα* with initial M.— which amount to over three hundred (310), I have also compared with the whole verbal inventory of the English language so far as it begins with that letter. To my surprise they make up almost one-fifth of that stock, which on the authority of the Nation (vol. XX, p. 345.) can muster only 1,641 words, with initial M.

You will at once inquire: "What is the *nature* of these rejected Shaksperian vocables, which he seems to have viewed either as milk that would bear no more than one skimming" or rather as "beauty too rich for use for earth too dear?" The percentage of *classical* words among them is great, greater indeed than in the body of Shakspere's writings. According to the analysis of Weisse, in an average hundred of Shaksperian words one third are classical and two thirds Saxon. But then, he adds, all the classical elements have inherent meaning, while half of the Saxon have none. The result is that of the significant words in Shakspere one half are of classical derivation.

Now of the *῞Απαξ λεγόμενα* with initial A, I call 262 words out of 364 classical, and 152 out of 310 with initial M, that is 414 out of 674, or about four-sevenths of the whole host commencing with those two letters.

In doubtful cases I have classed those words only as classical, the first etymology of which in Webster is from a classical or Romance root In the Biblical *῞Απαξ λεγόμενα* the classical factor is enormous, namely not less than 69 per cent., while even in Shaksperian words of the same class it is no more than sixty-one.

Again, among the 674 A. and M. *῞Απαξ λεγόμενα* the proportion of words now obsolete is unexpectedly *small.* Of 310 with initial M, only one sixth or fifty-one at the utmost are now disused either in sense, or even in form. Of this half hundred a few were used in Shakspere, but are not at present as verbs, as to *maculate*, to *miracle*, to *mud*, to *mist*, to *mischief*, to *moral.* Also, *merchandized* and *musicked.*

Another class, now rarely written, are *misproud*, *misdread*, *mappery*, *mansionry*, *marybuds*, *masterdom*, *mistership*, *mistressship.*

Then there are slight variants from our orthography or meanings, as *mained* for maimed, *markman* for marksman, *make* for mate, *makeless* for mateless, *mirable*, *mervailous*, *mess* for mass,—*manakin*, *minikin*, *meyny* for many, *momentany* for momentary, *misgraffing*, *mountainer*, *moraler*, *misanthropos*, *mott* for motto, to *mutine*, *minutely* every minute.

None seem wholly dead words except the following eighteen. To *mammock* tear, *mell* meddle, *mose* mourn, *micher* truant, *mome* fool, *mallecho* mischief, *maund* basket, *marcantant* merchant, *mun* sound of the wind, *mure* wall, *meacock* henpecked, *mop* grin, *militarist* soldier, *murrion* affected with murrain, *mammering* hesitating,— *mered* only,— *mountant* raised up.

The "Απαξ λεγόμενα in Shakspere are often so beautiful and poetical that we wonder how they could fail to be his favorites again and again, for they are jewels that might hang twenty years before our eyes yet never lose their luster. Why were they never shown but once?

They remind me of the exquisite crystal bowl from which I saw a Jewess and her bridegroom drink in Prague and which was then dashed in pieces on the floor of the synagogue, or of the Chigi porcelain painted by Raphael which, as soon as it had been once removed from the table, was thrown into the Tiber. To what purpose was this waste? Why should they be used up with once using? Even the Greek drama that would never presume to let a God appear but for an action worthy of a God, was not so pervaded with horror of too much.

Some specimens of this class which all writers but Shakspere would have often paraded as pets, are such words as magical, mirthful, mightful, merriness, majestically, marbled, martyred, mountainous, magnanimity, magnificence, marrowless, matin, masterpiece, masterdom, meander, mellifluous, menaces, mockable, monarchize, moon-beams, motto, mundane, mural, multipotent, mourningly, etc.

About one-tenth of the remaining "Απαξ λεγόμενα with initial M, are descriptive compounds. Nearly all of them are among the following twenty-six adjectives: *maiden-tongued, maiden-widowed, man-entered, many-headed, marble-breasted, marble-constant, marble-hearted, marrow-eating, mean-appareled, merchant-marring, mercy-lacking, mirth-moving, moving-delicate, mock-water, more-having, mortal-breathing, mortal-living, mortal-staring, motley-minded, mouse-eaten, moss-grown, mouth-filling, mouth-made, muddy-mettled, maid-pale, momentary-swift.*

From this list, which is nearly complete, it is evident that such compounds as may be multiplied at will by a word coiner form but a small proportion of the words that are used once only by Shakspere.

Again, a majority of Shaksperian *῞Απαξ λεγόμενα* being familiar to us as household words, and needful to us as daily food, it seems impossible that he who had cared to use them once should have need of them no more.

Some specimens, all with initial M, are the words, mechanics, machine, maxim, mission, monastic, mode, marsh, magnify, majority, malcontent, malignancy, manly (as an adverb), malleable, manna, maratime, manslaughter, market-day,–folks,–maid,–price, masterly, mealy, meekly, miserably, mercifully, mindful, memorial, mention, merchant-like, mercenary, memorandums, mercurial, meridian, medal, metropolis, mimic, metaphysics, ministration, to moderate, misapply, misconstruction, misgovernment, misquote, monster-like, monstrously, monstrosity, moneyed, monopoly, mutable, mortised, mortise, muniments, mother-wit.

The letter *M.*, which has been the staple of the present paper, is probably a fair representative of Shakspere's diction in regard to words which he would term "seld-shown." The subject, however, deserves to be treated more exhaustively. Every letter ought to be investigated as a single one has now been, and more abundantly. Nor would the labor be arduous, if the task were assumed by any Shaksperian club and divided among a score of its fellows, as the work of lexicography was among the forty members of the French academy. Such an examination would conclusively confirm, or confute, the conclusions to which the facts now set forth have led. It would also suggest others, and those of still greater interest.

In drawing up catalogues of once-used words, if such a set of co-laborers would append to each word the name of the play in which it occurs, the Shaksperian dramas could be easily compared in a manner which has never hitherto been possible. The *῞Απαξ λεγόμενα* in each particular play would be readily drawn out in a table. Then it would at once become manifest how far the number of such words varied in different works, and whether it was greatest in the early, or middle, or latest period of Shaksperian productivity.

In a casual reading of Cymbeline and Henry VIII., more than three score words in each that are elsewhere unfound have struck my eye, but more hundreds must have been passed unnoticed. Aside from the 549 once-used words in Henry V., already mentioned, I know not that such verbal statistics have been gathered. But they would not be without manifold utilities. They would aid in judging by style concerning the genuineness of doubtful passages. They would show how far Shakspere's alms basket of such words, which he calls "fire-new," continued to the last, like charity, which never faileth.

The array of once-used words which has been drawn up in the present writing must, as I think, surprise any one who passes them in review. The further one pushes research in the same line, the more his wonder will grow. Of compounds with the pre-fix *re*, like *reiterate* and *resignation*, he will discover one hundred and fifty lacking two, no one of which he will meet with again. To the same class of vocables undiscoverable a second time belongs every word in the line, "Unhouseled, disappointed, unaneled," as I have already stated, and the *italicized* words in the following phrases:

"Horns *whelked* and *waved* like the *enridged* sea"

"Massy *staples*
And *corresponsive* and fulfilling bolts *sperr* up."

In the following nine lines, which are almost consecutive, the words in *italics*, numbering nine (or ten if we count *lash* which is no where else employed in the sense of the thong or cord of a whip), make their entrances and exits once for all.

"In shape no bigger than an *agate-stone*
Her *wagon-spokes* made of long spinners' legs,
The cover of the wings of *grasshoppers*,
The *traces* of the smallest spider's web.
Her wagoner a small *grey-coated* gnat
Her whip of cricket's bone, the lash a *film*.
Time out of mind the fairies' *coachmakers*
And sometimes comes she with a *tithe-pig's* tail,
Then dreams he of another *benefice*."

And yet Romeo and Juliet, the play from which this passage is extracted, was among Shakspeare's earliest efforts. Though a prolific writer for twenty years afterward, he had no occasion for any one of these words even once again,— and repeated the phrase "time out of mind" only on one occasion.

Nowhere perhaps will the student of Shaksperian diction be more astonished than in observing how *uncommon* is the repetition of the commonest words. Who would anticipate that such vocables as the following would never do duty but once? *Fuller*, *shoemaker*, *straggler*, *playing*, *crazy*, *sisterly*, *scholarly*, *profoundly*, *prodigiously*, *wordless*, *comeliness*, *restful*, *fitful*, *forefoot*, *forecast*, *springhalt*, *rinsing*, *flannel*, *frock*, *sprout*, *leech*, *salamander*, *flail*, *flake*, *cater*, *corpulent*, *beverage*, *navigation*, *salary*, *omen*, *obscurity*, *cataract*, *cathedral*, *symbol*, *gospel*, *inwardness*, *Jesus*, *disciple*, *apostle*, *exhortation*, *homily*, *dirge*, *papist*, *institution*, *fragile*,— or such word-clusters as, *definite*, *definitive*, *definitively*; or these five sprouts from one root, to *elf*, *elvish*, *elvish-marked*, *elf-lock*, *elf-skin*.

No one class of once-used words is more conspicuous in Shakspere than *alliterative* compounds. This fact will be clear from the following very partial register of such formations: *all-abhorred*, *all-admiring*, *bow-back*, *burly-boned*, *bugbear*, *bull-bearing*, *bull-beeves*, *blood-bespotted*, *brow bound*, *bate-breeding*, *blood-boltered*, *bow-boy*, *baby-brow*, *care-crazed*, *cloud-capped*, *counter-caster*, *cain-colored*, *canvas-climber*, *child-changed*, *custard-coffin*, *chamber-council*, *death-darting*, *dew-dropping*, *death-divining*, *deep-drawing*, *drug-damned*, *dove-drawn*, *dismal-dreaming*, *double-dealing*, *double-damned*, *deep-drenched*, *dumb-discoursive*, *ever-esteemed*, *fast-falling*, *folly-fallen*, *foot-fall*, *faultful*, *fitful*, *fiery-footed*, *fleet-foot*, *full-flowing*, *forceful*, *fraudful*, *feast-finding*, *false-faced*, *foul faced*, *free-footed*, *filly-foal*, *full-fed*, *find-fault*, *full-fraught*, *glass-gazing*, *gain-giving*, *grim-grinning*, *guts-griping*, *great-grown*, *hard-hearted*, *hard handed*, *heaven-hued*, *heavenly-harnessed*, *heavy-hanging*, *heart-hardening*, *hell-hated*, *highly-heaped*, *hoary-headed*, *hollow-hearted*, *hydra-headed*, *honey-heavy*, *honest-hearted*, *harvest-home*, *king-killer*, *love-lacking* *low laid*, *lack luster*, *love-letter*, *lack linen*, *lack-love*, *lank-lean*, *lass-lorn*, *long legged*, *lily-livered*, *lazar-like*, *long-lived*, *lean-looked*, *light-o' love*, *peace parted* *periwig-pated*, *proud-pied*, *pity-pleading*, *plume-plucked*, *pistol-proof*, *plot-proof*, *ripe red*, *riding-robe*, *riding-rod*, *surfeit swelled*, *cinque-spotted*, *sweet suggesting*, *saint-seducing*, *sober sad*, *sad set*, *sea-salt*, *sea-sorrow*, *sea-swallowed*, *silver-sweet*, *sober-suited*, *still stand*, *ship-side*, *spirit stirring*, *super.subtle*, *super-serviceable*, *sweet seasoned*, *summer swelling*, *summer steaming*, *sick-*

service, sly-slow, snail-slow, softly-sprighted, soft-slow, trumpet-tongued, tempest-tossed,, tongue-tied, true-telling, travel-tainted, virgin-violator, want-wit, water-walled, wave worn, war-worn, woolward, well-willer, well-won, water-work, wonder-wounded.

These words, and four or five thousand more equally excellent, which have been the golden language of the English-speaking world for three centuries since Shakspere, and which, belonging to the immortal part of their vernacular, will be so forever, we are apt to think he should have worn in their newest gloss, not cast aside so soon. Why was he as shy of repeating them as Hudibras was of showing his wit,

> "Who bore it not about
> As if afraid to wear it out,
> Except on holidays or so,
> As men their best apparel do?"

This question, why a full fourth of Shakspere's verbal riches was never brought to light more than once, is probably one which nobody can at present answer, even to his own satisfaction. Yet, the phenomenon is so remarkable that every one will try after his own fashion to account for it. My own attempt at a provisional explanation I will present in the latter part of this paper.

Let us first notice another question concerning the *῞Απαξ λεγόμενα*, namely that which respects their *origin*. Where did they come from? How far did Shakspere make them, and how far were they ready to his hand? No approach to answering this inquiry can be made for some years. Yet as to this matter let us rejoice that the dictionary of the British Philological society is now near publication. This work, slowly elaborated by thousands of co-workers in many devious walks of study on both sides of the Atlantic, aims to exhibit the first appearance in a book of every English word. In regard to the great bulk of Shakspere's diction, it will enable us ten years hence to see how much of it was known to literature before him, and how much of it he, himself a snapper up of unconsidered trifles, gathered or gleaned in highways and byways, or caused to ramify and effloresce from Saxon or classical roots and trunks, thus endowing his purposes with words to make them known.

Meantime, we are left to conjectures. As of his own coinage I should set down such words as mirth-moving, merriness, motley-minded, masterdom, mockable, marbled, martyred, marrowless, mightful, multipotent, monarchize, etc., etc.

Professor Skeat, the most painstaking investigator known to me of early English, has discovered the word "disappointed" in no author earlier than Shakspere. Nor has Shakspere made use of that word more than once, namely in the line:

> "Unhouseled, disappointed, unaneled."

In that line all the words without exception are *῞Απαξ λεγόμενα.*

The word "disappointed" is not employed by Shakspere in its modern meaning, but as signifying *unprepared*, or better perhaps *unshriven.*

But however much of his linguistic treasury Shakspere shall be proved to have inherited ready-made, whatever scraps he may have stolen at the feast of languages, it is clear that he was an imperial creator of language. Having a mint of phrases in his own brain, well might he speak with the contempt he does of those "fools who for a tricksy word defy the matter,"—that is slight or disregard it. He never needed to do that. Words were "correspondent to his command and, Ariel-like, did his sprighting gently." When has any verbal necessity compelled him to give his sense a turn that does not naturally belong to it?

It is very possible that Shakspere frequently shunned expressions he had once preferred and that because otherwise his style would become monotonous, and so cloy the hungry edge of appetite. According to his own authority, "when they seldom come they wished for come." And again:

> "Therefore are feasts so solemn and so rare,
> Since seldom coming in the long year set,
> Like stones of worth they thinly placed are,
> Or captain jewels in the carcanet."

In thousands of cases, however, Shakspere cannot have rejected words through fear lest he should repeat them. It has taken three centuries for the world to ferret out his *῞Απαξ λεγόμενα*, can we believe that he himself knew them all? Unless he were the Providence which numbers all hairs of the head, he had not got the start of the majestic world so far as that, however myriad-minded we may consider him.

An instinct which would have rendered him aware of each and every individual of five thousand words that he had employed once only would be as inconceivable as that of Falstaff which made him discern at midnight the heir apparent in Prince Hal, when disguised as a highwayman. In short, Shakspere could not be conscious of all the words he had once used more than Brigham Young could recognize all the wives he had once wedded.

In the absence of other theories concerning the reasons for the Shaksperian *"Ἅπαξ λεγόμενα* being so abundant, I throw out a suggestion of my own, which may stand till a better one shall supplant it.

Shakspere's forte lay in diversified characterization, and, in my judgment, when he had sketched each several character, he was never content till he had either found or fabricated the aptest words possible for painting its form and pressure even in all *nuances* most true to life. No two characters being identical in any particular, more than two faces are, no two descriptions as drawn by his genius could repeat many of the self-same words. Each of his vocables thus became like each one of the seven thousand pieces in a locomotive which fits the one niche it was ordained to fill, but is out of place everywhere else, yes even *dislocated.*

The more his ethical differentiations, the more his language was differentiated. His personages were as diversified as have been portrayed by the whole band of Italian painters, but being a wizard in words he resembled the magician in mosaic who can delineate in stone every feature of those portraits, thanks to his discriminating and imitating shades of color more numberless than even Shakspere's words.

It is hard to believe that Shakspere's characters were born like Athene from the brain of Jove in panoplied perfection. They grew. The play of Troilus was a dozen years in growth. According to the best commentators, "internal evidence favors the opinion that *Romeo and Juliet* was an early work, and that it was subsequently revised and enlarged. Shakspere after having sketched out a play on the fashion of his youthful taste and skill, returned in after years to enlarge it, remodel it and enrich it with the matured fruits of years of observation and reflection. *Love's Labor Lost* first appeared in print with the annunciation that it was "newly revised and augmented." It is now very generally regarded as a revision of a play which Shakspere had produced ten years before and named *Love's Labor Won.* Cymbeline was an entire *rifacimento* of an early dramatic attempt, showing not only matured fulness of thought but laboring intensity of compressed expression." This being the fact, it is clear that Shakspere treated his dramas as Guido did his Cleopatra which he would not let leave his studio till ten years after the non-artistic world had deemed that portrait finished.

Meantime the painter was penciling his canvas with curious touches, each approximating some fraction nearer his ideal. So the poet sought to find out acceptable words, or what he terms "an army of good words." He poured his new wine into new bottles, and never was at rest till he had arrayed his ideas in that fitness of phrase which comes only by fits.

Had he survived fifty years longer I suppose he would to the last have been, like Plato, perfecting his phrases. One couplet which as he left it reads:

> "Find tongues in trees, books in the running brooks,
> Sermons in stones, and good in everything,"

he might possibly have corrected and improved, as some commentator has done for him, so as to express more truth, if less poetry, making the words to stand:

> "Find *leaves* on trees, *stones* in the running brooks,
> Sermons in *books*, and *gain* in everything."

To speak seriously, "His manner in diction was progressive, and this progress has been deemed so clearly traceable in his plays that it can enable us to determine their chronological order." This view would have been accepted by Dryden, who treating of Caliban remarks: "His language is as hobgoblin as his person. In him Shakspere not only found out a new character, but devised and adapted a new manner of language for that character."

On first thought it may seem beneath Shaksperian dignity to be careful and troubled about verbal niceties. But no one will continue so to think who has once perceived how much pains our dramatist takes in delineating every one of his fools, and that in showing forth their minutest follies he works by wit and not by witchcraft.

The result of Shakspere's curious verbal felicity, is that while other authors satiate and soon tire us, his speech forever breathes an indescribable freshness.

"Age cannot wither
Nor custom stale his infinite variety."

In the last line I have quoted there is a *Ἅπαξ λεγόμενον*, but it is a word which I think you would hardly guess. It is the last word,— namely, "variety."[1]

In order to make sure of the thing he refused to repeat the word. Indeed, he calls "iteration damnable."

On every average page of Shakspere you are greeted and gladdened by at least five words that you never saw before in his writings and that you will never see again, speaking once and then forever holding their peace,— each not only rare but a nonesuch,— five gems just shown, then snatched away. Each page is studded with five stars, each as unique as the century flower, and like the night-blooming cereus,

"The perfume and suppliance of a minute."

The mind of Shakspere was bodied forth as Montezuma was appareled, whose costume, however gorgeous, was never twice the same, and so like Shakspere's own "robe pontifical, ne'er seen but wondered at."

Hence the Shaksperian style is fresh as morning dews and changeful as evening clouds, so that we remain forever doubtful in relation to his manner and his matter, which of them owes the greater debt to the other.

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[1]Though this instance [Ant. and Cleop., 2, 2, 241] is the only occurrence of *variety* in the plays, we meet the word once more in Shakspere's poems, namely, in the twenty-first line of Venus and Adonis:

"Making them red and pale in endless variety."

Not a few other words which appear once only in the plays, are also repeated in the poems. But it was the *ἅπαξ λεγόμενα* in the plays, and not in other Shaksperian writings, of which it was my aim to treat.

The Shaksperian plots are analogous to the grouping of Raphael, the characters to the drawing of Michael Angelo, but the word-painting exceeds the coloring of Titian. Accordingly, in view of Shakspere's diction, I would long ago have said, if I could, what I read in Arthur Helps concerning a perfect style, that "there is a sense of felicity about it, declaring it to be the product of a happy moment, so that you feel that it will not happen again to that man who writes the sentence, nor to any other of the sons of men, to say the like thing so choicely, tersely, mellifluously and completely." In the central court of the Neapolitan museum I observed grape-clusters, volutes, moldings, fingers and antique fragments of all sorts wrought in the rarest marble, lying scattered on the pavement, exposed to sun and rain, cast down the wrong side up, and seemingly thrown away, as when the stones of the Jewish sanctuary were poured out in every street. Nothing reveals the sculptural opulence of Italy like that apparent wastefulness. It seems to proclaim that Italy can afford to make nothing of what would elsewhere be judged worthy of shrines. We say to ourselves, "If such be the things she throws away, what must be her jewels!" A similar feeling rises in me while exploring Shakspere's prodigality in *Ἅπαξ λεγόμενα.* His exchequer must have been more exhaustless than the Bank of England, and he threw away more dies for coining words than the British mint ever possessed for coining money.

On the whole, in whatever aspect we survey the Bard of Avon I am reminded of the retired Boston merchant who, in his old age, reading Hamlet for the first time was enraptured. When asked how he liked Shakspere, his answer was, "How do I like him? *Like* is no word for my admiration. The truth is that not twenty men in modern Boston can write anything better than old Shakspere." I say ditto to the Boston man. Not more than forty men in Madison (the present company excepted) can produce plays superior to the old Shaksperian.

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A LIST OF THE CRUSTACEA OF WISCONSIN.

With Notes on some New or Little Known Species.

By Will F. Bundy, M. D., Sauk City.

The crustacean fauna of Wisconsin has as yet received so little attention that it is at present impossible to present, with even approximate completeness, a list of the species inhabiting her waters. The various dredgings in Lake Superior under the auspices of the general government, and a dredging expedition off Racine previously reported to this academy by Dr. P. R. Hoy, have furnished almost our whole knowledge of the crustacean fauna of the lakes on our borders, while the interior of the state remains almost entirely unexplored. A species of cambarus (C. virilis) from Sugar river, another (C. propinquus) from Madison, and an amphipod, (Orchestes dentatus), from the latter place, are, I believe, the only crustaceans that have been accredited to the interior of the state till within a very recent period. That our streams and lakes are extremely rich in crustacean life, is abundantly attested by the fact that not a single locality has been explored with any degree of thoroughness without revealing the presence of several species of the higher genera.

The species included in this list, with the exception of those found only in the great lakes, were all taken within the comparatively limited area included in the counties of Racine, Jefferson, Dodge, Fond du Lac, Outagamie, Dane, Sauk and Richland. I have received specimens from but a single locality each, in the greater number of these.

The following list embraces all the species of the higher orders known to inhabit the waters of the state:

Order: Decapoda.

Family: Astacidæ.

Cambarus acutus. Girard.

C. stygius. Bundy.

C. virilis. Hagen.
C. propinquus. Girard.
C. placidus. Hagen.
C. rusticus. Girard.
C. wisconsinensis. Bundy.
C. debilis. Bundy.
C. gracilis. Bundy.
C. bartonii. Erichson.
C. obesus. Hagen.

Family: Mysidæ.

Mysis relicta. Loven.

ORDER: AMPHIPODA.

Family: Orchestidæ.

Orchestes dentatus. Smith.

Family: Lysianassidæ.

Pontoporeia hoyi. Smith.
P. filicornis. Smith.

Family: Gammaridæ.

Gammarus limnæus. Smith.
G. fasciatus. Say.
Crangonyx gracilis. Smith.

ORDER: ISOPODA.

Family: Assellidæ.

Asellus intermedius. Forbes.
Asellopsis tenax. Hagen.

ORDER: PHYLLOPIDÆ.

Family: Branchipodidæ.

Eubranchipus bundyi. Forbes.

Family: Estheriadæ.

Limnetis sp.?

The genus Cambarus is the only representative of the family Astacidæ in the fresh waters of the United States east of the Rocky Mountains. These animals, popularly known as "crawfish" or "crabs," are our largest crustaceans. The great number of species, separated by characters generally obscure and difficult of definition, many of them remarkably inconstant, with an undoubted dimorphism of males and the not infrequent occurrence of abnormal individuals, render the study of this genus particularly perplexing.

The following key will assist in separating the species herein mentioned:

A.— Rostrum toothed near apex, at least when young.

B.— Rostrum long, pointed; first abdominal legs of male truncate; third joint of third and fourth thoracic legs hooked.

C.— Hands long and slender; fingers curved; cephalothorax densely tuberculate. C. *acutus.*

CC.— Hands short; cephalothorax smooth or nearly so. C. *stygius.*

BB.— Rostrum subquadrangular; first abdominal legs of male bifid; hooks on third joint only, of thoracic legs.

D.— Tips of first abdominal legs of male nearly equal, straight or slightly curved; two rows of teeth on lower border of brachium *very indistinct* or *absent.*

E.— Rostrum carinated above. C. *propinquus.*

EE.— Rostrum not carinated above; hands large; fingers gaping at base. C. *placidus.*

DD.— Tips of first abdominal legs of male unequal and recurved.

F.— Margins of rostrum converging in front; first abdominal legs of male long, thick, inner ramus swollen near apex. C. *wisconsinensis.*

AA.— Rostrum toothless.

H.— First abdominal legs of male truncate; three slender teeth at apex. C. *gracilis.*

HH.— First abdominal legs of male ending in two short, thick, recurved teeth.

I.— Dorsal areola wide. C. *bartonii.*

II.— Dorsal areola none. C. *obesus.*

Cambarus acutus (Girard) has been found in Racine county by Dr. Hoy. It occurs also in marsh ditches near Sauk City in company with C. obesus.

C. stygius (Bundy). Bulletin No. 1, Ill. Mus. Nat. Hist., 1876.

A number of small crawfish were sent me by Dr. P. R. Hoy, by whom they were found on the shore of Lake Michigan at Racine, having been washed ashore during a storm. Proving to be a new species, they were described under the above name. The rostrum is long and pointed, smooth above, foveolate at base; cephalothorax slightly compressed, smooth or slightly punctate above and finely granulate on sides. The dorsal area is narrow and the lateral spines acute, antennal plates wide, truncate, with short apical teeth; epistoma rounded in front, twice as wide as long; third maxillipedes hairy on inner and lower sides; hands short, smooth, serrate on inner margins, fingers short, nearly straight, ribbed and punctate above, with contiguous margins tuberculate, outer one hairy; third segment of third (and probably fourth) thoracic legs of male hooked. (The specimens were so badly mutilated during the transfer through the mail that I could not determine this point, not one of the three males sent me having the fourth legs remaining.) The first abdominal legs of male are short, truncate, with three short obtuse teeth directed outward from posterior margins of apex, leaving a smooth groove passing up on outer surface between these teeth and the anterior margin. The ventral ring of female is flat, transversely elliptical, with posterior margin slightly elevated. This species resembles C. acutus, but can be instantly separated by the short hands and non-tuberculate annulus of female. The color of these specimens when caught was a dark cream, darker along sutures. In alcohol they changed to a purplish black, not confined to the exoskeleton, but extending to the adjacent soft tissues.

C. *viriles* (Hagen) is our most abundant species. It will doubtless be found in all the streams of the state.

A male in my collection, taken on a fisherman's net at Jefferson, belongs to Hagen's variety A. It is the largest crawfish I have seen, measuring $6\frac{3}{4}$ inches from tip of telson to that of rostrum. The specimen has peculiar hooks on third segment of second pair of thoracic legs.

C. *propinquus* (Girard) is also a very abundant species, generally found in company with C. *virilis.* It is our smallest species. Of hundreds in my collection from various parts of the state, the largest measures only two and one-fourth inches from tip of telson to tip of rostrum.

C. *placidus* (Hagen) occurs sparingly in Fox river, from which stream I have received a single individual.

C. *rusticus* (Girard) has been found in Lake Superior.

C. *wisconsinenis* (Bundy). Bul. No. 1, Ill. Mus. Nat. Hist., 1876. Rostrum wide at base, much narrower in front, not depressed, slightly concave above and nearly smooth, margins not elevated above eyes, acumen short; cephalothorax oval, punctate above and granulate on sides; lateral teeth but slightly developed; areola narrow, wider behind; antennæ slender, shorter than body; epistoma variable, wider than long, lateral angles prominent; third maxillipedes bearded within, and below at base only; carpus with a group of small sharp teeth on inner margin; two rows of teeth on lower aspect of brachium; third segment of third thoracic legs hooked; first abdominal legs of male long, thick, bifid, nearly straight, reaching when folded under thorax to base of first pair of legs; external ramus longer, with recurved tip, inner ramus swollen near short, acute, obliquely incurved apex.

Racine and Normal, Ill.:

C. *debilis* (Bundy). Bulletin No. 1, Ill. Mus. Nat. Hist., 1876. This crawfish was found in the Little Baraboo river at Ironton, in company with C. *propinquus.* A single individual was also found in the Wisconsin river at Sauk City.

Rostrum wide, quadrangular, slightly concave above, teeth prominent, margins nearly parallel, acumen short and flat; cephalothorax slightly depressed, punctate above, granulate on sides; lateral teeth acute; dorsal area narrow, widest behind; antennal plates somewhat longer than rostrum; antennæ slender, reaching to base of telson; epistoma wider than long, truncate; third maxillipedes barbate on inner and lower sides; hands with two rows of teeth on inner margins; contiguous margins of fingers tuberculate; costate and punctate above, outer one hairy at base; third segment of third thoracic legs hooked; first abdominal legs of male long, bifid, nearly straight, outer ramus longer, recurved, inner ramus more abruptly curved near apex, not enlarged near apex as in C. wisconsinensis; tubercle or inner basal angle small.

C. *gracillis* (Bundy). Bulletin No. 1, Ill. Mus. Nat. Hist., 1876. Rostrum short, wide, depressed, toothless, concave above, nearly right-angled in front; cephalothorax laterally compressed, smooth above, granulate on sides; areola wanting; cephalic carinæ prominent, ending behind in callosities; antennal plates very small and narrow; eyes small; antennæ short and slender; epistoma rounded in front; third maxillipedes hairy on inner and lower aspects; hands large, smooth below, punctate above, strongly toothed on inner margins; fingers slender, gaping at base, depressed, contiguous margins irregularly tuberculate, outer one incurved, wide at base, movable one longer, tuberculate on outer margin near base; carpus with one large and several small teeth on inner margin; brachium with two rows of sharp teeth on lower margin; third joint of third thoracic legs of male hooked; first abdominal legs of male truncate, with several small apical teeth, the inner one longest, slender and directed obliquely outward; bases of these legs narrow and inserted into deep sinuses in the first abdominal segment; interpedal space long, narrow, reaching half way from small basal tubercle to apex of legs.

The second form male has shorter, less gaping fingers, smaller hooks on third thoracic legs and articulated first abdominal legs.

The annulus of the female is movable, small and round. It consists of two half-rings, each of which embraces one end of the other. Two tubercules on the anterior border are separated by a slight furrow that widens behind, covering the posterior border.

It occurs on the prairies in the vicinity of Racine, where it was found by Dr. P. R. Hoy, to whose kindness I am indebted for specimens.

It is also found abundantly along water courses in early spring at Normal, Ill. (Prof. Forbes).

Dr. Hoy found it burrowing in low grounds on the prairies, emerging from its holes at nightfall and after rains.

C. *obesus* (Hagen).

This is one of our largest and most abundant crawfish. Unlike most other species, it prefers stagnant water, frequenting ponds and meadow ditches, often wandering far from bodies of surface water, burrowing in wet fields and swales.

It is pre-eminently our burrowing species, sometimes extending its hole to considerable depths. I once followed a burrow twelve feet without unearthing its occupant or reaching the bottom of the hole.

This species is easily identified. The rostrum is short, toothless, depressed, concave above; areola wanting; first abdominal legs of male bifid, with two short, thick, abruptly recurved teeth.

The annulus of female is transversely elliptical, symmetrical, anterior and posterior margins bituberculate; fossa 8 shaped, constricted in middle by anterior and posterier tubercles; lateral angles rounded.

C. *bartonii.* (Erichson.)

I do not think this species has been found in the interior of the state. It occurs in Lake Superior.

It is similar to C. obesus. The rostrum is not so much depressed, is less excavated above and the areola is very wide.

The female annulus has the posterior border elevated and the lateral angles acute.

Mysas relicta. (Loven.)

This occurs in the Great Lakes. It has not been found in the interior waters of the state.

Orchestes dentatus. (Smith.)

With the exception of *Gammarus fasciatus* this is the most abundant species in the interior waters of the state.

Pontoporeia hoyi. (Smith.)

P. filicornas. (Smith.)

Both of these species inhabit the deep waters of Lake Michigan. They have never been found in the interior waters of the state, but their occurrence in the deeper lakes is probable.

Gammarus limnæus. (Smith.)

Found in the Great Lakes. Dr. P. R. Hoy has found it in a clear spring brook near Racine.

G. *fasciatus.* (Say.)

This is doubtless the most abundant of our crustacea. I have not failed to find it, in greater or less abundance, in every stream or pool that I have examined. It is particularly numerous in small brooklets whose beds are covered with deposits of finely divided vegetable debris.

Crangonyx gracilis. (Smith.)

This species has not been found in the interior waters of the state. It occurs in Lake Superior, and Professor Forbes finds it in abundance in central Illinois.

Asellus intermedius. (Forbes.)

Abundant in stagnant sloughs and slow running brooks about Sauk City. These Wisconsin specimens differ from the types of Professor Forbes in several unimportant details, especially in the shape of the ramus of the first genital plate, and the size of the second joint of the inner ramus of the second plate.

Assellopsis tenax. (Hagen.)

This species I have not seen. It is reported from Lake Superior.

Eubranchipus bundyi. (Forbes.) Bulletin No. 1, Ill. Mus. Nat. Hist., 1876.

This, our largest phyllopod, was discovered in small ponds of surface water at Jefferson. It was found in abundance in April, but after a few weeks entirely disappeared. Specimens found in two neighboring ponds, while indistinguishable in other respects, differed markedly in size and coloring. In one of these ponds in a densely timbered lot they were small, and pale in color, while in a pond exposed to the sun they were much larger and brilliantly colored.

Limnetis (sp.?)

In company with the smaller Eubranchipides above mentioned was found an apparently undescribed species of Limnetis. I have met with it in no other locality.

Dioptomus sanguineus. (Forbes.)

This beautiful little creature is an abundant inhabitant of the marshy pools and ditches near Sauk City.

THE CORALS OF DELAFIELD.

By Ira M. Buel.

The large collection of fossils made by the Geological Survey at Roberts' quarry, Delafield, Wisconsin, is surpassed in interest and scientific value by no other representation of Palæozoic fauna ever obtained from our state. It contains thousands of specimens almost perfectly preserved by the blue friable shale in which they were imbedded; and of the seventy species already distinguished, about one-half are new to science. The coralline representatives found here are of special interest to the student and naturalist.

The locality in question (Sec. 24, T. 7, R. 18 W.) lies on the southern shore of Pewaukee lake, and in the edge of a trough carved by glacial forces out of the lower layers of the Niagara limestone, and the soft underlying Cincinnati shales; the basin being occupied in part by the lake itself. By the removal of the limestone layers in the quarry, quite a surface of this shale was exposed, and as this formation somewhat resembles some of the Carboniferous shales, it was supposed by some inquiring mind to belong to that formation. A shaft was accordingly sunk at this point for the discovery of coal, and was not abandoned until a depth of fifty feet had been reached. The mound of rock and clay thrown out of this pit or shaft, the rain-washed monument of a geological delusion, was the source of all of the specimens obtained from that locality.

These corralline forms are all of small size, the smallest species measuring about an inch in length and about a tenth of an inch in diameter. The largest coral fragment is about two inches in diameter and consists of a sort of central base from which a number of slender arms branched out. Within these limits we find almost every possible variation in form, manner of growth, branching and surface markings.

The size, form and arrangement of cells and cell walls, are the principal distinguishing features of these corals; and as these features are mainly microscopic, the labor of identification of species and varieties among these thousands of specimens was not a small task. The Polyp or Bryozoan cells seldom exceed a hundredth of an inch, and in some species are less than a two hundred and fiftieth of an inch in diameter. The cell walls and interspaces are often dotted with pits or pores, the tubuli of some authorities, or studded with granules, whose dimensions are from one-half to one-tenth of the diameter of the cells. In the illustrated drawings these surface markings are enlarged from twenty to fifty diameters.

The term *corals*, as applied to these forms, does not necessarily imply that they belong to the radiate sub-kingdom. We find, indeed, that Professor Dana includes under this general term calcareous or honey structures formed not only by Polyps and Hydroids (Radiates), but by Bryozoans (Mollusca), and also by certain low vegetable forms.

In the classifications that have been made, the widest diversity exists; no two authorities seem to agree, and the same species is relegated even to different sub-kingdoms by leading naturalists. Of the thirteen genera recognized in this collection, Professor Whitfield has placed *Chœtetes*, *Monticulipora*, *Stellipora*, *Alveolites* and *Dekayia* under Corals; and *Trematopora*, *Fistulipora*, *Palæschara*, *Stictopora*, *Fenestella*, *Retopora*, *Alecto* and *Aulopora* under Bryozoans. S. A. Miller, of Cincinnati, classes the first group as Radiates of the Favosite group, *Fistulipora* as a Millepore, *Aulopora* as an Alcyanoid coral, and the remainder Bryozoans. Professor Dana differs from others in considering the *Chœtetes* and related genera Hydroids instead of Polyp corals, while Dr. Rominger, of Michigan, throws them out of the Radiate sub-kingdom altogether, and places the whole list under Bryozoans. The close relationship and gradation of forms observed in our specimens indicate that they should not be separated into as widely differing divisions as has heretofore been done.

Before considering this matter further, we will notice the relationships that exist between some of these forms. Beginning with those genera that are considered by all authorities as belonging to the Bryozoan order of Mollusks, we first notice the two representatives of the genus *Stictopora*, that are found in this collection. (Fig. 1 represents S. elegantula, and Fig. 2 S. fragilis.)

The genus is thus described by Dr. Hall: " A foliaceous branching coral, supported by smooth rootlike expansions; branches bifurcating and sometimes coalescing, celluliferous on both sides, with thin central axis. Cellules, oval tubes, not enlarged below apertures, distinctly oval with raised borders, nearly as wide as the cells within.

The distinctive features of these species lie in the mode of branching, size, shape and arrangements of the cells. Their resemblance to modern Bryozoan forms is manifest. This resemblance is still more plainly seen in the reticulated forms represented by Figs. 3 and 4.[1] These are incrusting forms with the cells on one side only. Fig. 3 is an undescribed species, referred to the genus *Retopora* by Professor Whitfield. Fig. 4 was described by Professor Whitfield, and his description is found in the annual report of the Wisconsin Geological Survey for 1877, p. 68, under the name *Fenestella granulosa*.

The more obvious characters of each form are as follows: The Retopora presents anastomosing branches with irregular, elliptical or linear, pointed meshes, upper surface of branches thickly covered with circular pores which are arranged in three or four longitudinal rows. In the Fenestella the branches do not reunite after separation, but frequently bifurcate and are connected at quite regular intervals by extremely narrow bars which divide the interspaces into oblong spaces or fenestrules. The pores in this form are arranged in lines, a single row on each margin of the branches or rays. The opposite surface of the frond is densely covered with very minute granules, hence the term *granulosa*, applied to the species.

Turning to those forms which more closely resemble living radiate corals, we notice first of all the delicately formed *Trematopora annulifer*, Whitfield, described in the Annual Report Wisconsin Geological Survey for 1877, page 67. Scores of fragments of this beautiful fossil are found imbedded in

[1] These figures refer to drawings placed before the association at the presentation of this paper in December, 1878. Some of the corals will be illustrated in Vol. IV, Wis. Geol. Surv.

the surface of some of the blocks of shale, and though their diameter is hardly larger than that of a knitting needle, their peculiar sharp annulations distinguish them at a glance. The surface pores are fine as needle points, yet under the microscope show in general an elliptical section and are separated by grooved walls giving to each opening a distinct margin or rim which is elevated into a sharp spine on the lower side. The genus *Fistulapora* exhibits a still further remove from the Bryozoan type. The larger cells in this series have plainly marked transverse partitions as in the Favosite corals. Still we have in some forms thin incrusting layers and masses built up by the superposition of these layers. Our collections contain several new species of this genus, two of which have been described. The two forms to which I wish to call your attention now are *F. solidissima* and *F. lens.* The surface markings in these species are nearly alike; the former presents solid, cylindrical or flattened stems, often branching, while the latter presents disk-like expansions with openings on one side only. The surface of the former shows very small elliptical cells, separated by comparatively thick walls or interspaces which are studded by minute pores arranged in one, two, or sometimes three rows between the cells. Twelve to sixteen of these larger cells are found in the space of an eighth of an inch, measured along the branches. In F. lens the cells are rather larger and the interspaces narrower; otherwise the appearance of the surface in these species is similar.

The forms already noticed are generally considered to be Bryozoans. The difference of opinion that has been referred to applies principally to the remaining forms, and at this point, therefore, we should look for some important fundamental distinctions.

The genus *Stellipora* stands nearest to those just noted, and, therefore, claims our attention. The beautiful form, S. polystomella, is one of our most common fossils: and although we obtain only fragments of its broad frond-like expansions, the star-like tubercles that stud its surface, when perfectly preserved, render it one of the most attractive species to the casual observer. Our species is identified with the form described by Nicholson in the Ohio reports, but presents some points of difference. This author states that the number of rays found on these star-like prominences is from eight to twelve. Ours display from five to eighteen of these processes. The raised hexagonal border which he notes in the interspaces between the stars is shown in but a single specimen in our collection, and only imperfectly there. The star-like prominences in our specimens are much more irregular in form and arrangement, and the pores occupying the interstellar spaces have plainly-marked raised rims as in the genus *Trematopora* heretofore described.

Closely resembling this species in some of its forms stands a newly described species *Monticulipora punctata*, (An. Report, Wis. Geol. Sur. p. 71). This is a very variable form, especially as to surface markings. It is a cylindrical, branching coral, the stems varying from one-eighth to three-fourths of an inch in diameter. Some specimens display tubercular prominences very closely resembling those of the form last described; others show none of these raised figures. The surface of all specimens referred to this species is studded with non-cellular, minutely porous interspaces separated by surfaces marked by cells and pore-marked walls, just such as are shown by representatives of the genus *Fistulipora.* About these interspaces the larger cells are sometimes arranged in radiating lines or ridges. In these forms the resemblance to *Stellipora* is very marked to the unassisted eye. Under the lens, however, the arrangement of cells, cell walls and porous surfaces of cell walls and interspaces brings out the resemblance to the other genus just mentioned. The only marked difference between this form and those described as *Fistulipora* is the presence and prominence of the interspaces, and these are mentioned by Dr. Rominger, of Michigan, as characteristic of the latter genus. This author would doubtless place it at once under that genus.

We present also three other very closely allied forms of the genus *Monticulipora.* These are nearly alike in mode of growth, of branching, and in thickness of cell walls.

A detailed description of the first species will serve as a basis for all. Prof. Whitfield describes it as growing in strong, solid, somewhat flattened, frequently branching stems, covered with rather prominent, rounded tubercles with concave interspaces. Cells polygonal, those on the tubercles not differing in shape or size from the others; ten to fourteen on the stem in the space of one-eighth of a linear inch. The cell walls are sharp, without intercellular pits or pores, but elevated at the angles so as to form low points. This description is abridged from that given by that eminent paleontologist on page 71, An. Rep't, before cited. *Monticulipora multituberculata* is the formidable name borne by this little fellow. *M. rectangularis* differs from this in the form and arrangement of cells; these are generally quadrangular, and are arranged in concentrically curved lines showing much the same arrangement as the engraved lines on the surface of a watch-case. The third form is almost intermediate between these two types in surface markings, but is of larger growth and has less prominent monticules. The pores are quite generally hexagonal and are arranged in straight or gently curving lines. This form is undescribed.

There is some doubt in my mind as to the existence of any constant difference between these three forms. The concentric arrangement of cells is sometimes observable at the ends of branches of *M. multituberculata*, and *M. rectangularis* does not always display this arrangement of pores over the whole surface. The elevated spiny angles which characterize the cell walls of the first named species are not always apparent, and are sometimes to be observed on the latter form. The undescribed form is too closely allied to the others to warrant a separate description or designation. The wide variation in form and features would seem to indicate that at most only varieties should be claimed for these forms. The genus *Chætetes* to which the four succeeding species are assigned was originally thought to include forms like the last, but its author described the increase of its cells as taking place by division. In most of the forms in which the method of increase of parts has been made out it has been found to be by a different process, and so the new genera *Monticulipora stenopora*, etc., were founded, and into these genera were gathered those forms that were found to disagree with the original genus in this respect. The most that we can say of some of these is that they are at present classed under the old genus because they have not been proved to belong to any other genus, i. e., their manner of growth has never been discovered.

C. atritus, the first form noted under this designation, was first described in the Ohio reports. It is distinguished by the presence of small quadrangular, conical eminences, which are thickly scattered over the surface of the coral, especially at the flattened ends of the branches. The specimens from Ohio are described as cylindrical, frequently branching forms, from four to seven lines in diameter and eight to ten corallites in the space of one line. Ours are much smaller, from one and a half to three lines in diameter and flattened, with ten or twelve corallites in the space of a line. *Chætetes Jamesi*, described likewise in the Ohio reports, has its representative here also. The walls of the corallite cells in this form show the extraordinary thickness exhibited by the Ohio form, but also show a well marked groove upon their summit, a feature that is not noticed by Nicholson in his descriptions, nor shown in a type specimen which I have examined from that state. This feature has been before mentioned as a characteristic of the Bryozoan genus *Trematopora*. *C. fusiformis* is a new species (see An. Rep't, '76, p. 70). This is a very minute form, less than an inch in length and an eighth of an inch in diameter. The cells are very minute, twelve to twenty in the space of a line. The cell walls are thick, sometimes with minute pores, sometimes with a well marked groove on their summits, and in other cases sharply ridged between the cells. The very close resemblance that exists between this form and *Trematopora annulifera* argues very strongly against their being placed in different sub-kingdoms. I have failed to find any characteristic in these two last species that should remove them from those of the genus *Trematopora*.

I desire also to call attention to some undescribed and perhaps previously unnoticed forms which I observed while classifying the collections of the state survey.

The first is a thin expansion found encrusting a fragment of a Brachiopod shell. The cells in this form are rather larger than those of any of the other species here noted, and seemed to be formed by the grouping in various ways of beautifully trilobate semi-circular walls, after the manner of the fancy designs known by the ladies as shell-work. The appearance of the surface is more suggestive of modern Bryozoans than any other form. I should judge that it belongs to the genus Alveolites. Another well marked but undescribed fossil is doubtless a *Fistulipora.* The manner of growth of this form is various. It sometimes appears as an incrusting coral, sometimes grows out into thin fronds, again is found in irregularly-lobed masses, and occasionally takes the form of solid cylindrical branches. Its comparatively large cells, 6 to 8 in the space of a line, are elliptical in outline and have prominent thin walls. These cells are irregularly scattered over the surface, sometimes in contact but oftener separated by interspaces which are studded with smaller circular or polygonal cellules. These are of very unequal size and seem to have no systematic arrangement. The sharpness of outline possessed by cells and cellules in this form makes it one of the handsomest of these little curiosities.

From the facts observed during my examinations of these fossils, and especially from that portion which has been herein presented, the following conclusions have been drawn:

1. Throughout the whole series here represented we find no strongly marked lines of separation, but rather a group of forms bound together by many points of similarity.

2. These relationships preclude the possibility that we have here the representatives of two sub-kingdoms.

3. The close relationship borne by some of these corals to forms distinctly radiate would seem to indicate that they hold an intermediate position between the radiate and molluscan sub-kingdoms. It would be a hopeless task to attempt to establish their exact relationships from these fragmentary skeletons.

4. The extreme variability exhibited by the fossils themselves precludes the existence of well-defined genera and species, and points out an error in the past whereby these arbitrary distinctions have been unnecessarily multiplied.

5. The most careful study of extended collections is necessary to enable the observer to fix the few distinguishing lines by which

nature has herself classified this fauna, and even then we must not expect to find divisions, but rather connected branches of one central type.

The small collection hastily gathered by an exploring party from a little mound of debris must necessarily represent but a small proportion of the life that really existed in the teeming seas of that geological epoch. Amateur geologists have here a rich field for original work, and may find unlimited opportunity for study and investigation.

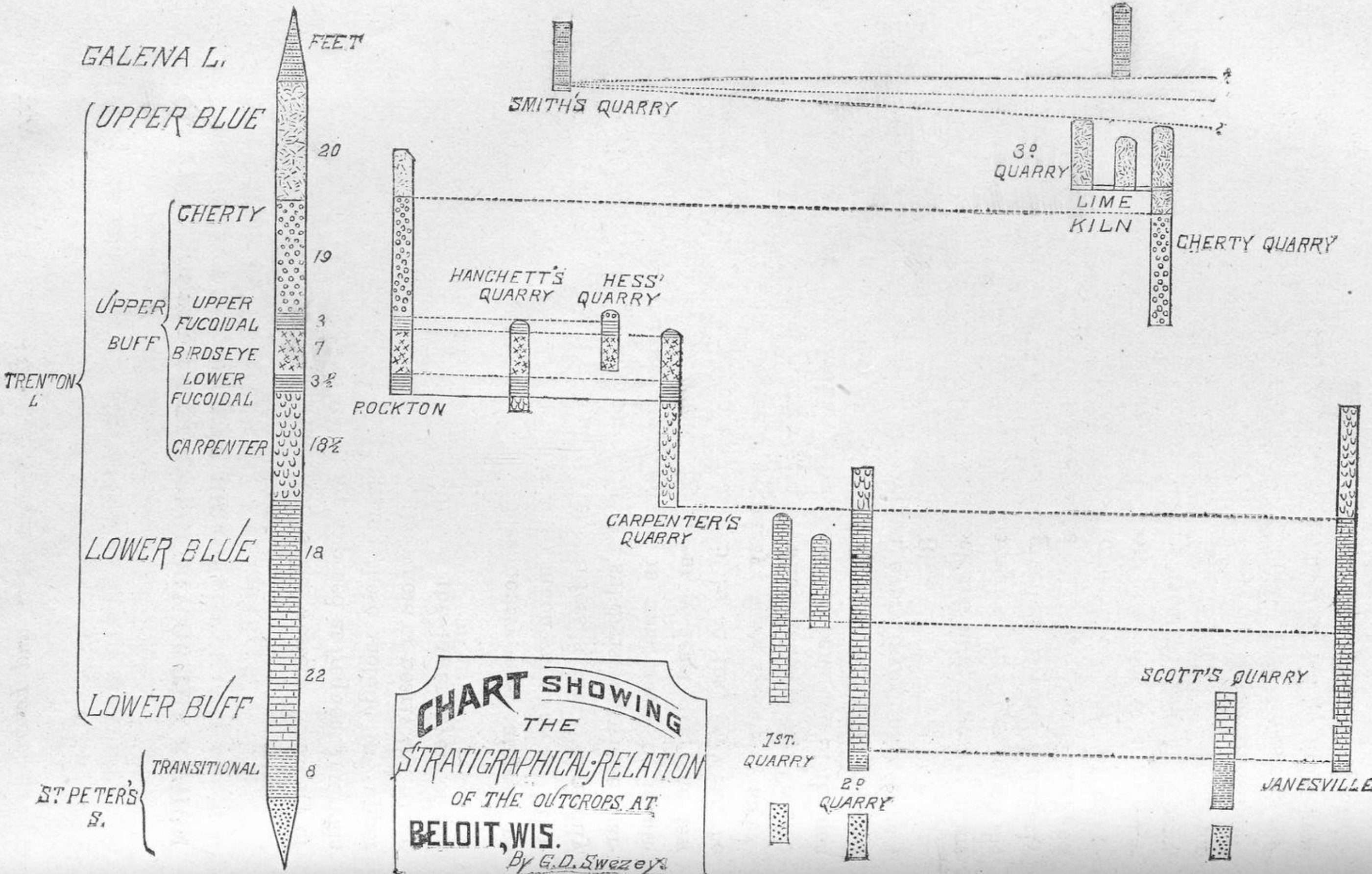
ON SOME POINTS IN THE GEOLOGY OF THE REGION ABOUT BELOIT.

BY G. D. SWEZEY.

Along the line of hills which forms the western boundary of the Rock river bottoms at Beloit are exposed at frequent intervals the outcropping edges of rock strata; these include the upper layers of the St. Peters sandstone, the whole or nearly the whole thickness of the Trenton limestone, and the lower layers of the Galena limestone.

The Trenton limestone, which consequently most interests us today, is a formation which presents so much variation in lithological characters, and to some extent in fossils, that it is readily divisible into a large number of distinct subdivisions, whose characters are so well marked that they can in most cases be identified with ease, and sufficiently persistent, at least over the few miles of extent with which we have to do, so that they can be matched with a good degree of certainty; there is scarcely an exposure of any extent in the region of whose place in the Trenton section we have any doubt. Moreover it happens that of the one hundred and eleven feet of Trenton limestone, we have exposed in one or more outcrops of the region, every layer unless it be a few feet in the horizon of the Upper Blue.

The subdivisions of our Trenton rock and their exposure in the various quarries and outcrops of the region are shown upon the chart; the names of the quarries are given as they are familiarly known by us at Beloit. Between the St. Peters sandstone and the Trenton limestone are eight feet or perhaps more of transitional layers; they include at the bottom a foot or so of sandstone, more coarse and impure than is usual with the St. Peters, above this five feet of impure limestone and shale, and at the top two feet more of coarse sandstone. Above these transitional layers we have twenty-two feet of Lower Buff limestone, separated by well marked shaly seams at least, if not by lithological characters, into three or four subdivisions, everywhere recognizable

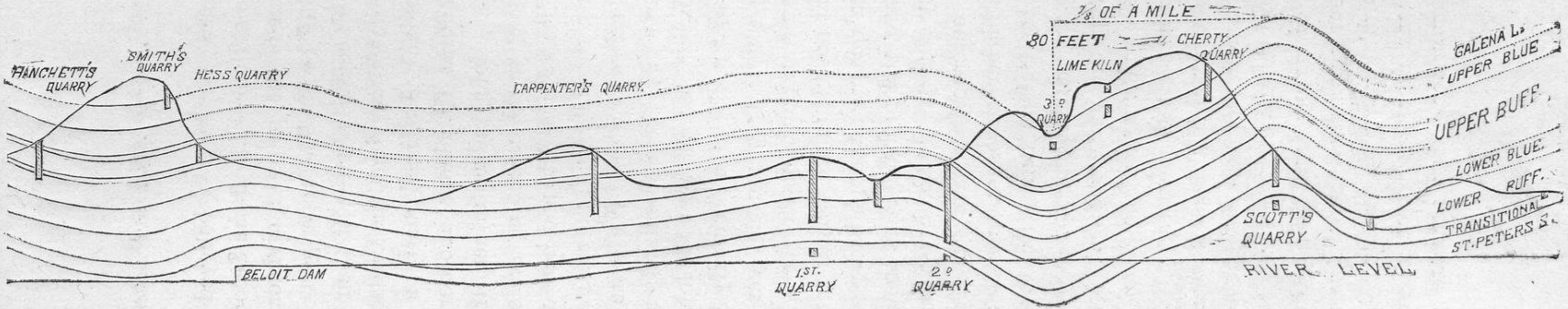

GALENA L.
FEET
UPPER BLUE
20
CHERTY
19
UPPER
UPPER
FUCOIDAL
3
BUFF
BIRDSEYE
7
TRENTON
L.
LOWER
FUCOIDAL
3½
CARPENTER
18½
LOWER BLUE
18
22
LOWER BUFF
TRANSITIONAL
8
ST PETER'S
S.
SMITH'S QUARRY
3º
QUARRY
LIME
KILN
CHERTY QUARRY
HANCHETT'S
QUARRY
HESS'
QUARRY
ROCKTON
CARPENTER'S
QUARRY
1ST.
QUARRY
2º
QUARRY
SCOTT'S QUARRY
JANESVILLE
CHART SHOWING
THE
STRATIGRAPHICAL RELATION
OF THE OUTCROPS AT
BELOIT, WIS.
By G. D. Swezey.

in the region as well as at Janesville. Above these are eighteen feet of Lower Blue limestone with two layers of a few inches each in thickness, one highly crystalline, the other very fossiliferous, easily recognizable in the three quarries which include this horizon. The Upper Buff limestone has been divided by Prof. Chamberlin into five subdivisions, known by us at Beloit as the Carpenter, Lower Fucoidal, Pseudo-birdseye, Upper Fucoidal and Cherty beds respectively; the lower and upper of these are still further divisible, as shown on the chart, and their divisions recognizable throughout the region and questionably as far away as Janesville. The Upper Blue limestone which completes the Trenton section is estimated at twenty feet in thickness, although as we shall see, this cannot be certainly determined.

Beginning with Scott's quarry, we have the transitional layers or nearly all of them, and just below, separated by a few feet unexposed, the characteristic St. Peters sandstone; in the Second railroad quarry, a mile and a quarter to the south, we have a portion of these layers exposed, and above them the entire thickness of Lower Buff and Lower Blue, and, in the broken and nearly inaccessible upper layers, probably the lower part of the Upper Buff layers; in two other quarries less than a mile from this, we find the same horizon, including the crystalline and fossiliferous layers before mentioned. In a ravine below Carpenter's quarry also, the Lower Blue layers are exposed. Carpenter's quarry forms the next step in the ladder, and here the exact matching becomes difficult owing to the broken and weathered condition of the top of the second quarry, and so we are obliged to call in the aid of the large quarry west of Janesville, which includes both of these horizons. There is in the very bottom of Carpenter's quarry a well marked shaly seam; a similar seam is found near the top of the second quarry, eighteen feet above the junction of lower buff and lower blue. At Janesville a seam is found seventeen feet above this junction, and at about this horizon the shaly fossiliferous Lower Blue layers pass by insensible gradations into the compact, unfossiliferous Carpenter beds. The fact that nearly all the subdivisions are a little thicker at Beloit than at Janesville, makes the difference of a foot in the height of this seam above the junction, just what we should expect; and so it is believed that this well marked seam is the same at Janesville, at the Second quarry and at Carpenter's, and it is made the point of division between the Lower Blue and Upper Buff beds. The upper part of Carpenter's quarry shows the Lower Fucoidal layers with their characteristic conchoidal fracture and brown markings, the Birdseye and in the very top the Upper Fucoidal. At Hess' quarry, a mile and three-quarters farther south, and at Hanchett's, another mile beyond, as well as at Rockton, four miles farther, these same layers are shown. Our next step in the ascending scale is made by the Cherty quarry, four miles to the north, and here our ladder breaks again and we must cross the state line and steal a few facts from our Sucker neighbors to splice it with. We learn from the Rockton quarry that the Cherty beds lie immediately above the three feet of Upper Fucoidal layers, and, although the lower part of the chert-bearing beds at Rockton are of a decidedly brecciated structure, while at the Cherty quarry they are not yet, we must conclude that they are the same, only laid down where the waves broke more violently, as might not be unlikely eight miles away. Moreover, the very top of Hess' quarry, although badly weathered, seems to be in this same horizon, and probably just about matches with the bottom of the Cherty quarry. In the upper half of this quarry and the two adjacent outcrops, we have the Upper Blue beds, while in one of them a higher exposure, separated by thirteen feet unexposed, shows the Galena beds with their characteristic *receptaculites*. The exact matching of these three quarries is a hopeless task; but among the numerous shaly seams there are two in each quarry that are well marked and about the same distance apart, which are believed to be identical. If this is so, the thickness of the Upper Blue layers is at least sixteen feet, and above this there is seven and a half feet between the top of the third quarry and the bottom of the upper exposure at the lime-kiln. Between these limits of sixteen and twenty-three and a half feet we may exercise our Yankee faculty of guessing; our guess is twenty feet. At Smith's quarry we find this junction of the Upper Blue with the Galena limestone which falls somewhat between the limits above mentioned. Our estimate gives the

DIAGRAM SHOWING

UNDULATIONS IN THE ROCK STRATA AT BELOIT, WIS.



total thickness of the Trenton limestone at one hundred and eleven feet.

It will thus be seen that the matching of our Beloit quarries is an interesting problem, somewhat complicated, but not too difficult; a class of college students, with a little oversight and direction from the teacher, are able to work it out with interest and satisfaction. We have just about outcrops enough, and very few superfluous; seven of our Beloit exposures are needed to complete the ascending scale.

Having now matched our exposures and determined the thickness of the various subdivisions, we have only to determine the altitude of each in order to learn whether there is any dip or undulation in the strata as traced from quarry to quarry; or whether they are, as shown on the chart, entirely level. The exposures lie mainly on a north and south line in the face of the west bluff of Rock river; moreover, the river, being set back at this point by the dam, affords a level base line; the altitude of the exposures above the river has been repeatedly taken by the aneroid barometer, and the average of these results is believed to be correct within a very few feet. The undulations which are thus detected are shown in the diagram, although of course greatly exaggerated. It will be seen that the four quarries farthest north show a considerable and quite regular dip to the south, amounting to eighty feet in seven-eighths of a mile; from here the strata rise again to the second quarry, beyond which they continue with but a slight and nearly uniform dip to the south. North of Scott's quarry there are two places where the junction of sandstone and limestone is shown in the road, from which we learn that the dip is sharp to the north. In the upper diagram the strata are traced still farther south, and also north through Janesville to Fulton; and although we know nothing as to minor undulations, we see that in general the strata are almost exactly level except where they drop down so abruptly at Beloit, constituting a little anticlinal elevation and a deeper synclinal depression of eighty feet; indeed, from Fulton to Rockton, a distance of thirty miles, the fall is only ninety-four feet; while at Beloit, as we have seen, the fall is almost as great in less than a mile. Although we know nothing about minor undulations between Afton and Fulton, the exposures about Beloit are so numerous that no considerable undulations could exist undetected.

The exposures represented in the diagram do not all lie in a direct line by any means, but those which are of most interest as indicating these marked undulations do lie almost exactly in a north and south line. Hess' and Smith's quarries lie considerably to the west of this line, but another small exposure to the east of them, and more nearly in line, indicates almost exactly the same slight dip as they.

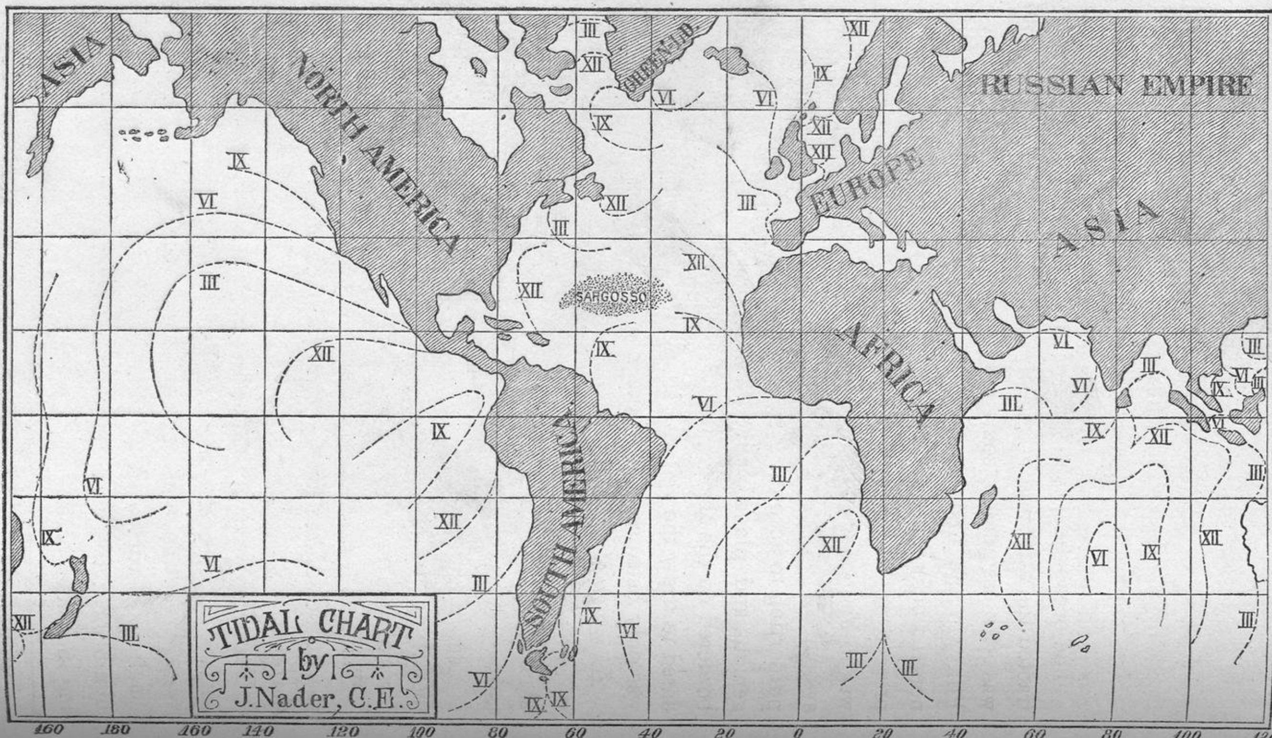
These outcrops all lie in the eastern face of the line of bluffs which forms the western boundary of the present Rock river bottoms. As we have seen, the Galena limestone is only found capping the highest hills. In the corresponding line of eastern bluffs, whose height is about the same, the Galena limestone is everywhere found, and the Trenton occurs only in the bottom of a deep ravine at Turtleville. This shows that the dip is prevailing eastward, which is to be presumed, since Beloit lies in the eastern slope of the north and south geanticlinal axis, which made Wisconsin the oldest state of the American continent, if not the oldest in the Union. The crest of this great geanticlinal runs down to the west of Beloit, giving our strata a slight slip to the east, amounting to about twenty-five feet in the five miles between the limekiln and the ravine at Turtleville. The undulations already traced are, therefore, of the nature of small anticlinal ridges and synclinal valleys crossing the main geanticlinal axis of Wisconsin. They are, of course, very small compared with it, but much more abrupt. The existence of similar, but much more extensive, humps on the camel's back is indicated by the fact that in two localities further south, in Illinois, the St. Peters sandstone comes to the surface; at Beloit it drops about to the river level; at Rockton the river runs over Trenton limestone; at the rapids south of Roscoe I have not seen the exposure, but from the rock and fossils I judge that it cuts through either the Lower Blue or, more likely, the Birdseye beds. But in Ogle county, Illinois, although the river is not at all abrupt to this point, the sandstone is found far above the river. A similar area is mapped by Worthen further south, in Illinois.

Without dwelling longer upon the stratigraphical relations of our rocks we pass on to note one or two points of interest in their later geological history.

The two lines of bluffs already mentioned which are the boundaries of the present Rock river bottoms, with their stratified Champlain gravels, were not only the banks of the Champlain lake into which the river expanded as a flood from the melting glacier, but they were also the banks of a rather remarkable channel which the preglacial Rock river cut for itself to the depth of over four hundred feet through Trenton limestone, St. Peters sandstone, Lower Magnesian limestone and into the Potsdam sandstone; at least this was the depth as shown by the artesian well at Janesville, and at a point a few miles lower in its course it could not have been much less. That it is a preglacial valley is evident enough from the fact that the path of the glacier, as shown by striæ at Hanchett's quarry, was almost exactly west or squarely across the Rock river channel. This fact is in itself interesting as being the only case, so far as I know, in which glacial striæ are found outside the Kettle morain to indicate the direction in which the glacier had moved previous to the retreat and subsequent advance which formed the Kettle morain. The direction of the glacier in our region had been conjectured from some meagre data to be about southwest; the discovery of these markings is therefore of interest as showing that the tongue of ice which produced them, apparently a continuation of the Lake Michigan glacier, was, at this point at least, deflected perhaps by a valley to the north of the quarry, so as to move due west; this being the case, the banks of our preglacial valley were doubtless originally higher even than now, so that this ancient channel must have had rather a remarkable depth. Its width at Beloit is three to four miles; a few miles farther south it narrows to one and a half miles. At Rockton the confluence of the Pecatonica with Rock river constituted quite a lake in the Champlain period, but it does not represent so large a preglacial valley since the bottoms between Beloit and Rockton are underlaid by rock as shown in several places, showing that the Champlain floods escaped over the low rim of rock at that point and determined their own limits in the unstratified Champlain deposits farther back. But to the east of Beloit the wells even do not strike rock, so far as I know, and so our deep preglacial valley must have had a width of three to four miles at Beloit, and farther north still greater. This is explicable from the fact that the soft St. Peters sandstone would be easily and extensively undermined by the river, so that the greatest depth of the channel may probably be only along a narrow channel in the middle into which the river cut its way and in which it lay until it was lifted out by the accumulating deposits from the melting glacier, widening as it was lifted higher and higher until it covered the present extensive bottoms.

The successive levels through which the river sank from this point are three in number, everywhere observable, besides some other terraces intermediate and not so well marked. The present river lies as a narrow stream, in general closely skirting the western bluffs and in places running upon the rock itself. The cause of this is detected by careful measurements with the aneroid barometer, which shows that the general level of the bottoms is somewhat higher on the eastern side than on the western, from which we infer that the rise of land to the north which set the river to cutting its terraces, was also, to some extent, a rise to the east of us, tipping the river over against its western bluff.

These rambling notes are presented not so much in the hope of enlightening as of interesting you in some of the geological questions which have interested us at Beloit.



TIDAL CHART
by
J.Nader, C.E.
ASIA
NORTH AMERICA
GREENLD
RUSSIAN EMPIRE
EUROPE
ASIA
AFRICA
SARGOSSO
SOUTH AMERICA
60
40
20
0
20
40
60
160
180
160
140
120
100
80
60
40
20
0
20
40
60
80
100
120

THE TIDES.

By John Nader, Civil Engineer.

The ocean tide, this mysterious breathing of the sea, has attracted the attention of man from the earliest ages, and the cause was often assigned to some mysterious, if not supernatural agency. Pliny, in the first century, must have been studying the phenomena before he exclaimed, "Causa in Sole Lunâque;" as we proceed in this investimation we will see how nearly correct Pliny was in his remark. Since the announcement of the Copernican[1] system of the universe, many theories have been advanced, all purporting to account for the tides. Some of these were very ingenious and plausible, while others, as we will subsequently see, bordered on the absurd. "Descartes,"[2] as Guillemin says, "first dared to draw the veil and sound the mystery, and if he failed, it was only because of his preconceived ideas of the solar system."

As we shall endeavor to deduce the cause from the effect, we will first investigate the various phases and features of the phenomenon as they actually occur, and then endeavor to assign the cause. Considerable observation and study are required to obtain a clear understanding of the varied features of the tide, of the disturbing influences arising from various sources, and of the form of the true and distorted waves.

The first feature observed, is the periodic rising and falling of the surface of the ocean and the movement of the consequent currents.

The tidal wave in its simplest form is a long undulation of the surface of the ocean, the length of which is the distance between two consecutive high or low waters; the vertical range is very small when compared with the length, but increases as the length diminishes; the time, however, is and remains the same excepting in special cases.

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[1] Nicolaus Copernicus. Born Feb. 9, 1473, Prussia. Died May 24, 1543. System de Mundi, 1507–1530–1543.

[2] Descartes. Born, 1596; died, 1650; 54 years.

The attending currents are the motion of the water on the slopes of the waves in obedience to gravitation. The excursions of these currents, at any particular point, are of short duration; the motion of the wave is so rapid compared with the current that a point in moving down one side is elevated by the advancing wave and left on the reverse slope to return and repeat the journey. It is not uncommon during still weather, to observe objects floating to and fro with the currents during several successive tides.

The figure of a normal or undistorted wave is nearly equal to a curve of sines of a circle whose diameter extends from high to low water with the center at mean level; if the semicircle and the half wave are divided into an equal number of parts, the sines and distances are the co-ordinates of the curve. As a rule the advance slope of the wave is the steeper of the two, for the axis is always inclined forward, owing to the resistance of friction. By comparing a diagram of an observed tide with the theoretical one, the distortion, if there is any, is at once recognized.

In the deep water of the ocean the volume necessary to form the wave in proportion to the force meets with little resistance, whereas in shallow water the resistance of friction from the bottom becomes considerable, and the wave which is thereby retarded in its progress is modified and the horizontal force is transformed into a vertical one; the water in front of the wave is drawn down to form the wave, thereby making the previous low water lower while the momentum of the wave heaps the water upon the obstructed portion, making the high water higher; and while the range is thus increased the length is proportionally diminished.

The tide is often much distorted by storms, so much in fact at times, as to almost lose its identity. A remarkable case occurred in New York Bay in the summer of 1869; it indicated that a vere storm was raging somewhere on the Atlantic ocean which arrested for a time the progress of a portion of the wave; the entire volume arrived in due time, but in a distorted form.

The force of the wind has also a great effect upon the tides in bays and rivers where at times every feature is disturbed beyond recognition. In the Delaware river in the winter of 1851 and

1852 the tide at Fort Delaware fell continuously for 36 hours in consequence of the wind blowing down stream, and instead of six feet the fall was actually fourteen.

The tides have their origin in the oceans and thence proceed to our shores, part of the time as forced and part of the time as free waves, that is to say, they are moving part of the time under the action of the tide-making force and when by the earth's rotation they are removed from this influence they continue under their own *vis-viva* until again brought within the influence of the same cause. After investigating some of the peculiarities of the tides on the coasts, we will return to the ocean wave. After reaching the coast the tide enters every bay and river within its scope, and, while doing so, undergoes many modifications. The range is subject to change with every change in the cross-section, so that observations along a river will vary considerable even at short distances. In extensive bays the fact is more marked than in rivers, the range, which is increased by the contraction of the inlet, is at once diminished when the wave enters and spreads in the basin, but, while the influx is retarded, the main wave passes by, the ocean falls and efflux begins before the bay is filled to the ocean level, so that the bay never rises to a level with the ocean and for the same reason also, never becomes as low. The Delaware and Chesapeake bays are cases of this kind; the Mexican gulf is one of the most extreme and will receive special notice further on.

The time card of steamers carrying on small tidal rivers is a curiosity to those not familiar with such rivers, some of which have scarce one foot of water at their entrance at low tide, so that the boats are obliged to enter and leave the river on the tide wave and their time must vary from day to day as we find the tides do vary. On large tidal rivers the case is different. Vessels will meet several tides during one trip, as, for instance, on the Hudson river, New York. The tide which passes New York city at 8:13 A. M., reaches Albany at 3:30 P. M., with a mean velocity of about 17 miles an hour so that the length of the half wave, from high to low water, is about 100 miles.

A boat leaving Albany at high water, at say 15 miles an hour,

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on the *ebb*, reaches low water in a little over three hours; then at the rate of twelve miles an hour on the *flood*, reaches high water in $3\frac{1}{2}$ hours more 40 miles above New York, which point (New York) it makes in $2\frac{1}{2}$ hours more and is then within 20 miles of the next low water. On the upstream trip the conditions would be different. Here it would only be a question of speed between the boat and the wave, and if the boat left at low water on the first of the *flood* current, it would meet the contrary current about 20 miles below Albany. The fact is that the trip upstream is made in less time than that downstream.

The tide of Long Island Sound and the East river, is remarkable in several respects. That portion of the tide which enters at Sandy Hook moves slowly up the narrow channel of the East river and a few miles above New York encounters another portion of the same ocean tide which entered the Sound at Montauk Point and flowed back through the Sound over 100 miles in the meantime.

With a reasonably fair idea of the tides, the most remarkable feature may appear to be their regularity, but by the time the novelty has worn off there may also arise some doubts upon that point in the mind of the observer.

If the observations should begin at a particular time, there will be two precisely similar waves, in something less than 25 hours. In the course of a few days, during which the tides will appear later each day, the two tides will become unequal in range, at the same time both may be higher or lower than when first observed, the evening tide may be the greater yet it is just as possible that the morning tide will be the greater of the two, depending entirely upon the time when the observations commenced.

Before progressing any further we will be obliged to assume some means of comparison to enable us to pursue the subject intelligently. Now, if we find that the phases of any two or more distinct phenomena run parallel, or in other words coincide, we may conclude that one is either the cause or companion of the other.

The phases of the tide compare in point of time exactly with those of the moon so that the moon is either the cause of the tides or their companion subject to the same laws.

The two equal tides take place when the moon has no declination, i. e., when in the plane of the earth's equator no matter what its position otherwise may chance to be. When the moon moves north or south of the equator the tides become unequal. In most localities the highest of the two will be the one following the upper transit during north declinations and lower transits during south declinations; when the tides observed do not succeed the transit which attends their formation, the exact reverse of this is true. Leaving aside the semi-diurnal inequalities, the highest tides occur at new and full moon and are known as *spring tides*, the least tides occur when the moon is in her quadratures and are known as *neap tides.* The highest of the high tides occur when the full or change takes place during maximum declinations, then one of the waves is much larger than the other, in some localities the inequality is so great as to compound the two waves to such a degree that only one distorted wave is apparent in 24 hours.

The mean time from the moon's upper transit to the succeeding high water, during a lunation, is called the "Corrected Establishment" or the "Establishment of the Port." The establishment is used by mariners and others for calculating the time of the tide from the position of the moon.

In the Gulf of Mexico the tides are more complicated; in Galveston Bay two very small irregular tides are observable in 24 hours when the declination of the moon is small, when this increases either way, the two become unequal until only one high water is recognizable in 24 hours; this continues several days before and after maximum declination.

By careful obseavations the two compounded waves are observable unless affected by local disturbances which latter often exceed the range of the tide which is from one-half to two feet.

The foregoing facts illustrate the general features of the tides and warrant the assumption that the moon is in some manner connected with the same.

If we examine the coast lines of continents we will observe a general similarity in some while in others we may even compare their details and in either case find remarkable resemblance which has suggested the idea, to some of our geographers, of joining the continents and assuming lines of cleavage.

South America, Africa and Oceanica have a strong resemblance; the locations of such detached portions as the Falkland Islands, Madagascar, New Zealand, Ceylon and Formosa are notable; the Fjords of Norway and Patagonia and the Firths of Scotland resemble each other closely, while the serrated S. W. coast of Ireland is the duplicate of the to coast of Maine. In these localities the tide impinges upon the coast in the same manner, in each case, both as to direction and impulse.

We may further observe the work of erosion of the average tide and of the greater at maximum declinations in the double indented coasts on the west of the continents, the first impulse of the tide being from west to east in nearly all cases.

According to the usually accepted theory of the tides, the moon elevates the water of the ocean by attraction. Now, if we admit of attraction, we must also admit of its laws according to one of which, bodies attract with a force in direct proportion to their masses. The mass of the sun is such that his attraction upon the earth is 170 times greater than the moon's and the tide should be in proportion to the respective attractive powers of the two bodies.

Reclus in "The Ocean" says that, "the solar tides would be 5000–6000 feet high if the true cause of the tides was not to be found in the difference of attraction exercised on the waters of the different parts of the earth." The difference of the moon's attraction on the near and remote sides of the earth is just twice the difference of the sun's, while the sun's attraction is 589 millionths of the earth's gravity and moon's attraction is only 34½ millionths. The centrifugal force at the equator due to the earth's rotation is the 1-289th part of the earth's gravity and hence only six times greater than the sun's attraction, while it is more than 1000 times greater than the moon's.

The moon's assumed affinity for aqueous matter we will not consider since we have as yet no reason to doubt that gravitation is the same throughout the Universe. In space, all matter is attracted alike, that some bodies are heavier than others is that they, on account of their density, contain a greater mass, and gravity acting upon this mass gives them their preponderance, at the same time one volume will respond to the force of gravity as readily as another, nothwithstanding their different densities.

A tide occurs at opposste sides of the earth at the same time, that is, one tide follows the upper transit of the moon and another the lower one in the same place. The water is said to be drawn away from the earth on one side and the earth away from the water on the remote side.

We know that two forces acting in the same direction are represented by a simple sum of these forces and that attraction acting from one side through a body upon matter on the opposite side will only aid gravity in holding that matter more securely on that side, but, it is admitted that matter is heavier on the earth's surface on the side remote from the sun, which fact recalls the argument, that if anything is affected by foreign attraction it will be affected most by the superior force.

Argumeet aside, the tide is certainly obedient to the moon, but the manner in which this is brought about, is the problem to be solved.

One feature of the phenomena which is used to show that the tide is raised by attraction, is the difference in range of the semi-diurnal tides at different positions of the moon, the higher tide succeeding the superior transit and north declination and the lower transit during south declination, showing that the moon draws the water after it.

Now let us see how true this is.

The Atlantic tide is created in the southern part of the South Atlantic ocean, and moving eastward reaches the African coast shortly after the moon's transit at that place. Thence it moves north and west, reaching the United States coast twelve hours later. The other side of the wave in connection with the Arctic tide moving east and north, reaches Ireland four hours later, and Dover straits twelve hours later still; so that in some places it is the tide after moon's transit, and in others the previous tide which is observed, so that the facts become reversed.

Nearly all authors on this subject — the tides — are satisfied with nothing less than the great South Pacific ocean, a thousand miles off shore, for sufficient space to create the tidal wave, whence they propagate the same all over the world from east to west. Some think it possible that there is a new impulse given in each ocean, while others think that possibly the origin may be in the Indian ocean.

That these speculations are not all correct is evident from my chart of co-tidal lines, which is based upon a collection of actual facts from undoubted sources. One tide reaches the west coast of Africa at the same moment of absolute time that another reaches the east coast of Madagascar. These can by no means be the same wave in any form, for, after reaching the respective coasts, a portion of each moves southward, these meet near the Cape of Good Hope, unite, and move south as one wave. One tide arrives on the west shore of Patagonia at the same time that another reaches the east shore of the Falkland Islands. These move south and three hours later unite near Cape Horn and go south as one wave. These also are two entirely separate and distinct tides coming from different oceans and from opposite directions. A still more remarkable tide is that which reaches the north end of New Zealand from the northeast. This tide travels south between Austria and New Zealand, is met by a tide from the Indian ocean south of Tasmania, is turned eastward and makes the detour of New Zealand in time to pass the succeeding tide off the north end of the Islands. This wave is an important one, as it returns just in time to reform the Pacific tide. The Society Islands, where there is no perceptible tide, lie in the node between the ascending and descending tides. The solar tide of 5–6 inches reported at Tahiti is occasioned by the shifting of the node of no tide, and the time, three hours before and after noon and midnight, is occasioned by what is termed *priming* and *lagging* of the lunar tides.

The tide of the Indian ocean has its origin near the center of that ocean, first moving decidedly north and east and then spreading in a north and west direction. Owing to the great difference in depth of this ocean and the consequent resistance, this tide is subject to movements peculiar to itself. The Maldive islands are situate 400 miles west of Ceylon, and occupy 500 miles in a north and south direction by about 40 miles wide. They are divided into numerous groups by navigable channels of various depths. It is estimated that the whole number of islands or Atols is no less than 50,000, of which the largest is not more than eight miles in circumference. These islands present an immense barrier to the tide, so that one portion is retarded, while another portion moves on rapidly, making a large detour returns upon the retarded portion like an eddy. The wave moving westward with a great convex front reaches Madagascar, and, passing around both ends, fills Mozambique Channel with high water in half an hour. One portion then passes southwest and meets the south Atlantic tide, the other advances north to Cape Gardafui, then moves eastward with great velocity to the west coast of Hindoostan, filling the Arabian sea, and moving south reaches the Maldives eight hours after the main wave has passed the same point and entered the Bay of Bengal. It will also be observed that the easterly side of this tide moves both north and south of Australia; that on the north meets the Pacific tide coming through Torres straits with a difference of four hours; that on the south travels beyond Tasmania and joins a portion of the Pacific tide, a portion of both, however, returning from South Victoria along the Antarctic continent to maintain the equilibrium.

The tide in the north Atlantic, which had its origin partly in the Arctic Ocean and partly in the south Atlantic, moves eastward with an extensive convex front and divides on the south end of the British Isles; one portion enters the British Channel and reaches Dover Straits in the time that the other portion makes the entrance to the North Sea. The tide in Dover Straits meets another which entered the North Sea twelve hours before but passes to the east of it and along the coast of France and the Netherlands, and combining with a later tide from the north reaches the Skaw 17 hours after passing Callais, while another portion of this identical tfde travels south along the English coast. It will be observed that there is always a whole wave in the North Sea which is necessary to preserve the sequence.

The tide passing north to Martha's Vineyard is met at Nantucket by a tide from the north four hours younger, but of greater range, so that it is superposed on the lesser. The origin of the Arctic tide is not traceable for want of data in these waters, but it ascends Baffin's Bay.

These facts go to show that we have not one but a number of primary tides, created in different ocaans, acting in perfect harmony and repeating their phases as regular as the moon.

Observing the different motion of the tides, we find that they obey in a particular manner certain varying impulses. Primarily they move east, then west, with a general tendency to and from the equator, unless interrupted by obstructions; and on the whole they partake of a circular motion in time to repeat.

The original motion is a most decisive one, not as though a stone were thrown into the water, as the comparison is sometimes made, but just the opposite; the greater portion of a whole ocean appears to heave and rise into a wave in the course of a few hours.

In particular cases the impulse and its direction are very marked owing to local interferences, such as the Bay of Fundy, where the tide reaches the coast with great rapidity through a tongue of very deep water, then moves endwise to the east, meets with the obstruction of Nova Scotia, so that the wave is augmented to alarming dimensions. Bristol Channel and a number of other places are subject to similar tides, but of less extent. On the other hand we find some cases of this kind in the other direction, for instance the entrance to Magellan Straits, where the tide attains a range of 40 feet and over.

The foregoing are facts obtained from long observation and careful investigation of the phenomena. More than 4,000 reliable data were collected from tables such as "Bowditch's Navigator," Imray & Son's "Lights and Tides of the World," and various other equally reliable sources. These were all reduced to absolute time (Greenwich time) and platted on charts in their respective places. The true places of the co-tidal lines were thus obtained, and the result shows beyond a doubt that the charts of co-tidal lines now in use are far from being correct.

In Pliny's judgment the cause was the sun and moon. We will also examine the remarks of others on this subject and see how they agree.

The New Am. Cyc. says: "The close relation which the times of high water bear to the times of the moon's passage shows that the moon's influence in raising the tides must be greater than the sun's. In fact, while the whole attraction of the sun upon the earth far exceeds that of the moon, yet, owing to the greater proximity of the latter, the difference between its attraction at the center of the earth and at the nearest and most remote points of its surface, which produces the tides, is about two and one-half times as great as the sun's attraction at the same points."

The argument might answer if the moon was very near the earth so as to gather the water by tangental motion into a wave beneath it until resisted by gravitation, provided also, that sufficient time was allowed, as we are not dealing with a uniform envelop of water, but with oceans separated by continents, and although the velocity of the tides is great, the translation of the water is very slow, not such as would be required in heaping up the water as the moon overleaps the continents from ocean to ocean, whereas the wave comes up as though impelled by a sudden blow or stroke. An article on tides by repulsion in Vol. 4 of the South. Litt. Mess. says: "When La Place[1] had ascertained the fact, that as the mooon passed over the Atlantic it was low water under her and the swell was on either side of her, north and south, and the further from the moon the greater the swell, is it not a little strange that he should have come to the conclusion that the moon was drawing up the water towards herself," further from the same; "as whenever the moon is vertical to any place, it is invariably low water." These remarks, when properly applied, are correct so far as the position of the wave is concerned. Bowditch in Mech. Celeste says: "By a remarkable singularity, the low water takes place when the two bodies are in the meridian, and the high water when they are in the horizon; so that the tide subsides at the equator, under the body that attracts it." It appears that the origin of the tide is lost sight of, and the time

[1] La Place. Born, 1748; died, 1827.

required to reach the position of the moon is not considered, there are times, however, when the tide is under the moon, but, if we find the moon over a low water, we will also find the parent wave in deep water on on the same meridian.

The same author, in the Messenger, further says: "And as when the moon approaches the meridian of Babelmandeb the the water will fall there but continues its elevation on each side as at Tonquin and in the Mozambique channel," also, "the tide remaining up so long at Tonquin gave rise to the notion, very strangely indeed, that two tides met at that place."

It is merely necessary to examine the facts in both these cases and we will find that the falling water at Babelmandeb is the tide of the moon's previous transit, while tide in the Mozambique channel is that of the immediate transit which culminates with the moon in the Indian ocean in longitude 80° E., but does not culminate in the Mozambique until the moon has reached longitude 20° W. The tide at Tonquin is a part of the Pacific tide which enters the China sea through the Bashee and Balintang channels between Formosa and Luzon and also a small tide from the Balabec straits, these unite before reaching the Gulf of Tonquin, leaving a regular tide of 4 to six feet. There is, however, a tide from the Indian ocean through Mallacca and Sunda Straits which causes interferance in the Gulf of Siam, a body of water similar to the Gulf of Tonquin but ten degrees of latitude nearer the equator; the spring tides are only two feet at the entrance but increase at the head of the gulf, so that the tide at Cape Liant is seven feet, the time, however, is disturbed, so that the tide rises three hours and falls nine.

The irregularities of the tide in the Straits of Magellan are drawn upon to favor the theory by repulsion. These tides are such as would serve any desirable purpose. When the moon is over the Atlantic the tide of the previous transit begins to rise at Cape Virgins, so also the tide at Cape Pillar on the Pacific side and in Cockburn Channel.

During three hours when the moon is over the Atlantic the tide at Cape Pillar does three hours of its rising phase, at Cockburn Channel the last two of falling and the first of rising and at Cape

Virgins the last of rising and first two hours of falling of the previous tide. Now when the moon is over the Pacific, say at 8 hours absolute time longitude 120° W., then it is two hours after high water at Cape Pillar, just high water at Cockburn Channel and seven hours after high water at Cape Virgins or five hours before the high water succeeding the present moon. These conflicting phases make the problem a very complicated one and the more so when we consider the difference in range of these irregular tides. The tide at Cape Pillar at the sixth hour rises scarce five feet; in the Cockburn Channel at the eight hour about five (this tide divides into two branches on Clarence Island), while the tide at Cape Virgins at the thirteenth hour has a range of from 38 to 42 feet. Reclus says that Fitzroy has measured tides here as high as 62 feet. When we further consider the variable width of the Straits with two narrows one of which is described as being like the passage of the Bosphorus from the Black Sea into the Marmara Sea we may conclude the hopeless task of attributing these irregular fluctuation to any supposed cause whatever.

An article in Vol. 34 of the *American Journal of Science* says: "That the attraction of the moon regulates the times of the tides caused by the gulf stream, is evident." Further: "Why does the ocean always run swiftly into the Mediterranean Sea? No doubt to keep up the subterranean stream which passes out of the Bay of Mexico, called the Gulf stream."

Here, in the first place is a confounding of cause and effect, the motion of the tidal wave gives a slow progressive motion to a large volume of water.

The waters of the Atlantic set in motion by the tide reflect from the African shore and move in a north west direction; after passing Cape St. Rogue the waters tarry six months under a tropical sun before discharging from the Straits of Florida a volume of water equal to 3,000 Mississippi rivers.

The constant current into the Mediterranean, which until recently was considered to be the consequence of the evaporation of the Sea, is only a surface current, and quite recently a strong counter-current has been discovered at the bottom of Gibraltar Straits setting into the Atlantic and accounting for the greater part of the influx at the surface. This strait is large enough to give freedom to tides and currents, its length from Cape Trafalgar to Europa point, in Sprin, is 36 miles and its width from 15 to 24 miles, its depth is as much as 5,000 feet. The spring tides at Lissa Island in the Adriatic are $2\frac{1}{2}$ feet and at Tripoli, Syria, at the extreme east end of the Mediterranean, they have still a range ot two feet.

The New American Cycopedia speaking of the age of the tide, says: "This delay, which even at the Cape of Good Hope amounts to fourteen hours, is still the subject of investigation and is probably mainly due to friction."

If the co-tidal charts by Whewell and others were correct, then the delay would be much greater than that here mentioned, these charts give the origin of the tide in the Pactfic, thence they bring the tide across the Pacific and Indian ocean and into the Atlantic by way of the Cape of Good Hope. The fact is, that this tide is created in the Atlantic ocean exactly on time with moon's transit, so that there is no delay at this point, but from here the tide is twelve hours in reaching the United States coast, 14 in reaching Spain and 24 hours readhing Dover by way of the British Channel.

From the same source we have the following:

"If the tides arrive at the same place by two different channels and one of them is retarded behind the other by six hours, in consequence of traveling a longer route or in shallow water, the semidiurnal tides will be destroyed by an interference of the waves, that is, by the high water of one being superimposed on the low water of the other."

This phenomenon is common, two waves unite and one is the result, but, this does not prevent a recurrence after 12 lunar hours, the semidiurnal phase is not affected whatever in any case. If the tide divides on, and passes around an island, the two parts unite and reform the wave, or, if the tides meet in a long channel the result is a commotion which stops both until drawn down by the succeeding tides, or they may, as at the Isle of Wight, cross each other both ways causing double high tides. In this case the tide from the west enters the "Solent" at ten hours with a range of 7–8 feet, and; the main wave having reached Spithead, another tide enters here a little over one hour later with a range of 12 to 13 feet so that there is a second highwater $2\frac{1}{4}$ hours after the first at Southampton; the second tide passes also to the west from "Cowes," after the first has passed making a second highwater at Lymington. The two parts of the tide wave remain distinct. The point of meeting or crossing at Cowes is such as to leave the general direction of the tides at rightangles and it can be practically demonstrated that two sets of waves may travel in this manner without any serious interference.

When, however, two tides meet in the ocean, they will form one wave which will progress in a direction which will be the resultant of the previous direction and velocity of the separate tides. We must also bear in mind that in all, excepting rare cases, the tide in questiou supplants a wave which occupied the same location twelve hours before.

The semi-diurnal tides may differ to such an extent that the high water of one corresponds with the low water of the other, and may leave the impression of but one or a *diurnal* tide, the appellation however is a misnomer, there being really no diurnal tide; the distortion can be recognized in every case so that there is no question of there being two tides. This compounding is not due to a meeting of tides but to the location and time of the originating impulse as we will see further on.

It happens at times that one of the semi-diurnal tides is entirely lost and this is, when the wave is small and travels free by its own *vis viva* after the force is removed, being constantly retarded in its movement and at length unable any longer to overcome the resistance of friction the wave finally stops and is lost. This is the case in the gulf tides when the moon's declination is maximum, one of the waves is so small that it is scarcely distinguishable and is at times lost before reaching the coast.

Where two tides of the same type but of nifferent origin meet as at Cape Horn and the Cape of Good Hope, they unite and become one wave. The meeting of the tide off the capes will account for the turbulent condition of the sea in these localities.

Only a few of many tidal theories are noticed tn the foregoing remarks and it appears that in every instance the authors had a very indifferent knowledge of tidal phenomena.

Reclus was not far from correct when he said: "Cotidals according Whewell are accepted, but it is not certain that things occur in this way, in fact, it is ascertained that in each oceanic basin the tide seems to start from the centre and be propagated in all directions parallel to the general direction of the coasts."

This remark was a welcome discovery when the accompanying chart began to develop into its present form, so also a statement from an unknown author, that the tide possibly had its origin in the middle of the Indian Ocean: also the report of a British naval commander who stated "that instead of a constant current westward around the Cape of Good Hope he had known vessels to remain stationary for days and even to drift to the east." Now it is safe to say that had the tide been constantly in one direction around the cape, as it was supposed to be, then the current would also have been constant in the same direction.

The tides of the British Channel and North Sea have already been mentioned but owing to so singular phenomena a special investigation will be interesting. The accompanying chart shows every feature of these remarkable tides.

The cotidal lines represent the progress at each hour of absolute time; the age of the tide is reckoned from its origin in the South Atlantic when the moon transits the meridian of Greenwich at 12 o'clock noon or midnight (this is at full and change).

A tongue of deep water, over 2,500 fathoms deep, extends far into the Bay of Biscay, and when the tide arrives off this point it makes a decided lateral move into the bay with great velocity, from the 14th to the 15th hour, at the same time approaching the shores of Ireland and England, dividing on Cape Clear at the 16th and Lands End a little before the 17th hour; the southeast portion passes through the British channel and Dover straits in a northeast direction at the 24th hour, and it here passes a tide on its west 12 hours older. Meeting as they do, these tides reflect and preserve their individuality on opposite shores in opposite directions. The tide from the channel keeps along the east shore and meets a tide off the coast of Jutland 12 hours younger than the one we have followed thus far. But where is our associate? While we were lingering in the channel, and the straits, he went around the longer way with great strides and met our predecessor at the point where we now are, just as we were tasting of the Dutch Rhine, and combining with him made the passage of the Skagger Rack and washed the shores of Gotheborg Sweden at 30 hours as we shall when 42 hours old. From Cape Clear the tide moves along the west shore of Ireland, the Western Isles and coast of Scotland, reaching the Orkney and Shetland Isles at the 21st hour. Here it divides, never to meet again; one part passes between the Islands and moves south along the coast of Scotland and England and at the mouth of the Thames at the 36th hour passes a Channel tide 24 hours old, its own associate is already approaching Jutland. The tide between the Shetlands and Norway moves rapidly southeastward through a belt of water over 100 fathoms deep, and at the 26th hour meets a channel tide 12 hours older, as we have before observed. When this Norway tide departs eastward a portion breaks to the westward and follows the main wave along the coast of Scotland, but, being delayed by several hours, causes a second high water, thus making apparent four highwaters as far as Peter Head. These four tides were attributed to the channel tides, but it is evident that if this was the case, the tides would be observed along the English rather than the Scottish coast. The middle of the North Sea has no tide, which is corroborated by careful soundings made by the British navy over a shoal where no oscillation was observed. From this it will be observed that there can be not less than two tidal waves in the North Sea at any time, and as many as four at one time during each phase, the resulting confusion of currents can easier be imagined than described.

A portion of the tide which we have been considering enters St. George's and Bristol channels, also the North channel into the Irish sea. The waves by St. George's and North channels meet near the the Isle of Man about the 23d hour, their range along the Irish coast was moderate, but the meeting produces a range of 20 feet and over.

The tide in the Bristol channel, charging straight from the sea into a nearly uniformly contracting channel, increases rapidly in range as it ascends the Severn. Entering with range of 20 feet it increases to 27 at Ilfracombe, to 35 at Bridgewater Bay, to 37 at Cardiff, 38 at Chepstow and to 40 feet at Bristol. Above Bristol the entire rise occurs in about two hours, and the fall in about ten. Here the resistance of friction is such that the axis of the wave is much inclined by the dragging of the front, and the impulse from the momentum of the volume. The front of the wave becomes steeper and the rear slope much longer, the latter being drawn to supply the next wave.

The *Mascarret Eager* or *Barre* is an exaggerated distortion due to excessive contraction either lateral or vertical. The immediate cause of this phenomenon is, that a sufficient quantity of water to preserve the form of the wave is unable to rise in front before it is overwhelmed by the heaped up water of the wave whose axis is inclined so far from the vertical that it breaks over and rolls along upon the surface. When occasioned by excessive lateral contraction, the *eager* forms at and follows along the shores of the stream, but when caused by shoals in the middle grounds it forms and follows up the middle of the stream, preserving its identity for a considerable time after passing the cause of the abnormity. A few short waves generally follow the *eager*, leaving high water immediately behind them.

While investigating the various phases of the tidal phenomena, it must be noticed that there always has been a determination to have the tide move with the moon from east to west, and owing to this desire many aspects have remained unnoticed, or have been disregarded because they happened to conflict with some theory under construction. In nearly all articles on tides the common remark is, that "in tidal rivers the tide always moves up-stream, even when this is in the opposite direction to that in which the moon appears to move." This would imply that tide should remain under the moon while the earth revolved to the east, and that the tides on the east shores are produced by the advance of the solid earth against the suspended mobile waters. It is true, the tide moves south along the east shores of Scotland and England, but, as we have seen, it is also true that at the same time there is a tide on the west shore of the Netherlands in the same latitude. The course of the Severn, before noticed, is eastward from the sea, so also the direction of the Bay of Fundy, with 70 feet tide. These facts are sufficient to show that the tide does not follow the moon in her apparent course from east to west, while the earth is revolving on its axis from west to east.

For the purpose of attracting attention to coincidences, a few of the principal mountain chains are given on the chart of which the tides and the conformation of the coasts are, however, the principal features. It will be observed that after forming in the deepest part of the oceans, the first point of impact of the tides is against the foot of a chain of mountains. The indentations of the coasts are not wholly the effect of tidal abrasion, as is indicated by the parallel position of the mountains, but indicate that the tide producing force now operative was active in contributing towards the formation of continents in a fluid much denser than that which it now propels.

By observing the beginning and progress of a storm at sea, we may form some idea of how nature has grown into equilibrium. When the storm begins the waves are varied in form and size and their motions are tumultuous, but when at length sufficient matter is set in motion to satisfy the conditions between the force acting and the surface under action, then the waves become perfect in form and their regularity will bear comparison with the tides.

The tide producing force necessarily acts upon all bodies of water, either great or small, but its effect is very different in lakes and inland seas from what it is in the oceans. In the former there is a constant and ineffectual effort to produce regularity, in the latter the oscillation is established.

The mass and extent of surface must be proportioned to the force. In inland lakes and seas there are continued fluctuations, but small, and the intervals are short, the duration being from a few minutes to several hours.

These oscillations are the result of the tide producing force and the irregularity is the effect of interference and reaction, the surface, mass and force not being in correct proportion.

The lake and also ocean tides may be illustrated by a simple experiment and the various phases and interferences may be produced just as they occur in nature.

If we take a basin of water and agitate the same, we may produce one or more waves; if now we regulate the impulse while we observe the motion, we may time the same so as to produce regular oscillations which will continue until a change of force takes place; whenever such change takes place either in amount or duration, interferences will appear which after a time will cause the wave or waves to come to a state of rest, but if the same impulse continues, the oscillations begin again, increase to maximum, diminish and again cease.

This will be the case whether the impulse be greater or less or the time faster or slower than that necessary to produce regularity. This is practically true of the great lakes, the oscillations observed are the effect of the tide producing force which is entirely disproportioned to the extent of the volume acted upon, the resulting irregularities recur in periods from which the tide may be determined by elimination.

There are many peculiarities attending the tides as they meet with the varied obstructions of the coast, prominent among these is that the range of tide is less at the most advanced portions of a continent than at either side. The advancing tide in these cases meets with the resistance of the submerged portion of the Cape long before reaching the coast and departs to either hand, thereby diminishing the tide at the cape, which, having reached the coast, divides, and by its momentum crowds upon that part of the tide already making in the bays or indentations of the coast on either side.

We have thus far followed the tidal phenomena through all their principal phases with the moon as the cause or companion of the same.

In order to deduce the cause of the tides we will refer to first principles and then compare facts with the laws of nature. According to Keppler's[1] two first laws, based upon the observations

[1] Johan Keppler, Wurtemburg. Born 1570, died 1630. 1st and 2d, 1609; 3rd, 1618, May 15.

of Tycho Brahé[1] and published in 1609, the planets revolve around the sun in elliptical orbits and their radii vectores describe equal areas in equal times., The moon is supposed to revolve about the earth in this manner, the orbit being elliptical with the earth occupying one of the foci. Now, Keppler's laws are strictly true when only one planet and the sun are considered, but in a system, they are subject to complicated pertutbations. Newton's[2] Principle, based upon Keppler's laws half a century later, is consequently subject to equally complicated modifications.

According to the laws of gravitation, all bodies attract each other in proportion to their mass and inversely as the squares of the distance, also, bodies which mutually attract each other revolve around their common centers of gravity. These apply to our whole system, and we may say, to the whole universe. Between the earth and moon there will be a point which will describe an orbit around the sun while the earth's center will describe a circle around this common center of revolution. There will appear some complication, for while the two bodies revolve about a common center, the moon is describing an elliptical orbit whose excentricity varies between 1-18 and 1-15 and whose major axis makes a complete revolution in about nine years in direct motion, and although both conditions cannot be entirely true at the same time, yet this will not alter the law while it modifies the results. When the moon is in quadratures both bodies are affected alike by the sun, as the common center lies in their mutual orbit. At this instant either law will apply as the respective orbits of the moon due to either law coincide at this point, and although it may be said that the earth has actual control, its force being at right angles to that of the sun at this point, the moon is actually performing a planetary orbit about the sun.

As soon however as the moon moves out of quadratures in the ellipse, the earth yields to the law of mutual attraction, on account of the dominant force of the sun, its center describes an undu-

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[1] Tycho Brahé, a Dane. Born 1546, died 1601. Rejected Corernicus.

[2] Newton, born 1642, died 1727. Principia, 1627.

lating course about the sun and the common center or point of revolution between the earth and moon describes the orbit.

The ultimate result of these antagonistic efforts is, that the point of revolution between the earth and moon fluctuates between the earth's center and the common center of gravity of the two bodies.

The earth revolves about the common center of revolution, which lies within its own volume, with the same regular velocity that the moon revolves in her orbit. This motion produces a centrifugal force, which, owing to eccentricity, is tangent to the earth only in the plane of the moon and the axis of rotation; the constant change of the axis causes this force to fluctuate between nil and maximum twice in a lunation, that is, nil at quadratures and maximum at syzygies.

The force thus produced, which I will call centrifugal preponderance, varies between the 1·900 and 1·500 of the centrifugal force due to the earth's rotary motion. The effect of the earth's rotation was to produce the spheroidal form of the earth and its present office is to maintain it with a flattening at the poles of nearly 26 miles; if this force were to cease, the oceans would retire to the poles.

Now a force equal to 1·900 part of this, acting uniformly and constantly, would, if we simply consider the result proportionate to the force, cause a flattening of 150 feet, but as we shall see, this force does not act uniformly or constantly, neither have we a continuous mobile surface to consider acted upon, so that this change of form is impossible. Should we however assume a uniform surface of water and taking this force as acting in the mean one-half the time on one-tenth of the surface on opposite sides, we would have a tide of seven feet which agrees with the protuberances of the Elipsoid of water produced by some highly scientific investigations.

The eccentricity of the force causes the same to deviate from the centrifugal force due to the earth's rotation everywhere on the surface excepting at two points; these are, the point directly under the moon and the point opposite. At other points in the plane of the moon's orbit it has a tendency of only slightly deflecting the earth's force, and in the endeavor to overcome the superior force of gravity the waters are thereby depressed shortly before being presented to the point of activity and hence are prepared to leap forward to meet the moon at its transit as the tides are known to do.

The centrifugal force is greatest in the plane of the moon's orbit and diminishes towards the poles of rotation in proportion to the cosine of the angular distance so that at the distance of 60 degrees it is reduced to one half. The centrifugal force of a rotating sphere is everywhere parallel to the plane of the equator; the components of this force at any point are: a force acting in opposition to gravity and a force at right angles to the same, having a tendency to move matter towards the equator. This is the case with the tides, for no sooner have they formed, in fact during their formation, they depart toward the equator.

To follow the recurring impulse upon the tides as they depart from their origin on their respective journeys must here be omitted for want of time, by comparing the cotidal lines on the chart with the moon's hour at the top and bottom of the chart, the effect can easily be traced.

In order to connect several other features of the tide with this tide-producing force, it will be necessary to define more closely the moon's position and the variable orbit which she pursues.

The moon's orbit is inclined to the plane of the ecliptic about $5\frac{1}{4}$ degrees so that her latitude cannot exceed this quantity, but the earth's equator is inclined 23° 26′ to the ecliptic, thence the moon's declinations will vary from 0 to 28° 40′ north and south of the equator. The maximum declinations also vary by twice the latitude by reason that the nodes of the orbit are not constant but have a retrogade motion so that the moon may occupy every possible position in a zone of 10° 40′. The declinations will be greatest when the line of nodes coincides with the equinoctial line, for here the earth's declination plus the moon's latitude will be the moon's declination. These maximum declinations coincide with the moon's quadratures at the equinoxes and with the syzygies at the solstices, and vary between these points in the interval.

We have seen how the moon assumes various positions from south to north of the equator in each revolution about the earth, and we will find that the oceans are differently affected during inferior from superior transits. For we will first suppose the moon in the plane of the equator which occurs at new and full moon in the equinox and in the quadratures at solstices. It is evident that the moon holds the same relative position to the sea under her as the lower transit does to the sea on the remote side, and the result is the same; but when we consider the moon in maximum north or south declinations then the conditions are entirely changed; the lower transit of north declination and upper of south decliation affect the sea further south than the upper north and lower south so that the results must be different for each pair. In order to illustrate, several tides of Cape Flattery on the Pacific coast are added to the sketch; these are sketched according to the reported observations of the U. S. coast survey.

The wave A 1 arrives arrives ahead of mean time after transit; B 1 is behind time; A 2 is separated one lunar day from A 1, and so on. These are the tides of max. decs. The tides A 1, A 2, etc., were formed by an upper transit with the moon at U, N. dec., or by a lower transit with the moon at L, S. decl., and the ocean at E will be affected alike by either; but since the line from the moon pierces the ocean north of the equator, the tide will be formed north of the mean origin and will come ahead of mean time. On the other hand, the tides B 1, B 2, etc., are formed by an upper transit with the moon at L, S. decl., or by a lower transit with the moon at U, N. decl., and the ocean at Q will also be affected equally by either; but since the line from the moon pierces the ocean south of the equator the tide will be formed south of the mean origin and will be behind time. The result is obvious; the wave B 1 being behind its proper place and the wave A 2 in advance, an overlapping takes place and the tides assume a mixed type. The tide travels by the rising of the water in front and the falling to the rear of the crest, hence the tide A in raising the rear slope of the tide B draws upon the volume and causes a degradation of the latter, the distance between B 1 and A 2 being greater than the mean interval, the depression also becomes greater as the water which should belong to one is in part taken up by the other. If these intervals were not oscillating as they are; but continuous in pairs, the result would be the same as in inland lakes.

The highest spring tides should take place during the equinoxes when the oceans are affected alike for both upper and lower transits by the maximum force for several days in succession, but from four years careful observations I have found the mean rise and fall greatest during the five months, August to December inclusive; also the highest and lowest tides and maximum and minimum rise and fall from November to February inclusive.

The tides are known to rise higher as the moon approaches the earth. As the moon approaches, the common centre comes nearer the earth's centre and the centrifugal force increases as the moon's motion increases from its closer proximity, hence the tides increase. The tides on opposite sides, or corresponding to different transits of the moon, are practically alike when the moon is on the equator, now since the impulse on opposite sides is about as 500 to 900 the question will arise why the effect is not in proportion to the cause. As the pendulum will return nearly to the point from which it has fallen so these oscillations would also nearly repeat themselves, but since other waves approach to form the succeeding tide it is only necessary that the impulse should be repeated at the regular intervals necessary for equilibrium. There are those who deny the existence of the force at the side remote from the moon, but the inequality of the semidiurnal tides is sufficient to prove the existence of that force.

It has been stated that the force is nil at the moon's quadratures, then why any tides at these phases? The nil force exists but an instant and as before remarked, these oscillations will nearly repeat themselves even when they are changing with an increasing ratio as they change when approaching quadratures at the equinoxes, in fact Newton said, that when these oscillations were fairly established, the luminaries might be removed, and the tides would continue for an indefinite time. We also find that the effect does not immediately follow the cause, for the inverse order of tides does not take place for several days after change of declination neither do the highest tides occur at full and change of the moon, nor the least tides in the quadratures.

A singular fact in nature, which is attributable to the tides, is the existence of the Sargossa seas in mid ocean. The tide in mid ocean is very small as has been ascertained at islands along the course of the tide. At the shores however, the tide is retarded and its range increased, so that the surface of the ocean is practically lower than its limits, forming a sort of settling basin whence the singular seas. A current chart by Bowditch shows a current from all directions towards the Sargossa sea in the Atlantic.

There is another question which arises and that is, why, if there is a primary tide in each of the southern oceans, there is not also the same in the northern oceans?

In the first place, the southern oceans are the largest and deepest and the effect produced upon them would preponderate over that produced on the smaller oceans. In the second place, the origin was not a matter of chance or choice but necessity, for as soon as the condensation of aqueous matter was sufficient to fill or to partly fill an oceanic basin, the tides began to move and as the oceans continued to increase, the motion was imparted to the increasing waters, the regularity of the impulse had the effect of producing the regular succession of tides of the oceans as the earth in its diurnal revolutions presented them successively to the tide producing force.

To sum up this investigation we have:

First. A primary tide in each of the southern oceans, and one in the Arctic ocean. These rise twice a day, and their appearance corresponds in time exactly with the moon's apparent motion. The semi-diurnal tides differ in magnitude with the moon's declination from the equator, showing that there is a tide force under the moon and also one on the remote side of the earth giving a tide following the inferior as well as the superior transit of the moon. The tides are greatest at the full and change and least at quadratures, and the range varies perceptibly with the distance of the moon.

Second. The moon revolves about the earth in an eliptical orbit, and by mutual attraction both revolve about a common center. This common center is the point attracted by the sun and describes the orbit common to both bodies. The earth's center describes an undulating line, being part of the time within and part of the time without the common orbit. The common center is a variable point, on account of the variable attraction of the sun on the two bodies, and varies or fluctuates between the earth's center and the common center of gravity of the two bodies. The earth revolves about the common center with the same angular velocity that the moon revolves in her orbit.

The resulting eccentric motion of the earth begets a centrifugal force which coincides with the centrifugal force of the diurnal revolution only under and opposite to the moon in the plane passing through the moon. At other plates it tends only to deflect the line of gravity. When the common center coincides with the earth's center the force ceases, and is maximum when these points are at their greatest distance. When the moon approaches the earth her velocity increases, also the angular velocity about the common center, hence also the centrifugal force. This force tends also to move matter towards the equator in the plane of its activity.

From the foregoing argument the following is deduced as the cause of the tides:

In the first place it is evident that every phase and feature points direct to the moon as the cause of the phenomena, but in the next place the laws of nature show very clearly that the moon is only the implement by which the superior controlling force operates, the moon's efforts as the satellite of the earth being due to the sun's influence. The sun is therefore the prime cause operating in accordance with the grand principle discovered by the great Newton and announced to the world 193 years ago, the principle of UNIVERSAL GRAVITATION.

ON A PROPOSED SYSTEM OF LITHOLOGICAL NOMENCLATURE.

By T. C. CHAMBERLIN, Ph. D., Director of the Wisconsin Geological Survey.

That our present system of lithological nomenclature is in some important respects unsatisfactory, it is needless to assert. It is inadequate, in that it falls far short of properly designating all the mineral aggregates that have now become subjects of description, and of not infrequent reference in geological literature. It is ambiguous, in that certain terms in common use are differently used by different writers. So common a term as *syenite*, and the not infrequent ones *melaphyr* and *gabbro*, are striking examples. It is inaccurate, in that it groups under the same term, rocks whose ultimate chemical composition varies widely, or those whose origin is diverse. It is mischievous, in that the individuality of its naming inevitably implies hard and fast lines which do not exist in nature. It is etymologically objectionable, in that terms are wrested from their derivative sense, and forced into incongruous applications. Thus the term granite is driven from its popular, and, as it happens in this case, proper application to a wide class of *grained* crystalline rocks, and restricted to a certain *mineralogical* aggregation.

That these objections are felt in greater or less degree is shown (1) by the *drift* in the signification of terms, (2) by the efforts made to restrict and define old terms, (3) by the introduction of new terms, (4) *by the compounding of terms, and* (5) *by the use of mineralogical names as defining adjectives.* As examples of compounding may be cited such terms as quartz-syenite, oligoclase-trachyte, quartz-augite-andesite, labradorite-diorite, hornblend-andesite, dioritic-gniess, hornblendic-biotite-gneiss, and so on through the long list of complex terms that characterize the later and more precise lithological discussions.

The essential features of the proposed system lie in the direction of this manifest tendency, and consist, essentially (1), in an effort to separate lithological terms into distinct classes, having reference to the several different attitudes from which the character of rocks may be viewed, as physical, chemical, mineralogical, petrographical; and (2), the introduction of a series of contractions, and a system of compounding terms, which shall render lithological names at once specific, self-explanatory and measurably quantitative. At the same time the mischievous implications attached to prevalent terms, fashioned after those applied to definite mineralogical species, are avoided.

Lithological terms are either adjective or nominal in character, and a complete series of each would greatly facilitate expression.

The following classification of terms, embracing mainly those already in use, will make more clear the place and function of the changes and additions proposed:

Lithological Terms.

A. Adjective.

Class I. Basis of Classification—The Physical Nature of the Constituents.

1. Fragmental. (Detrital, Clastic.)
   - Conglomeratic.
   - Sandy or arenaceous.
   - Clayey or argillaceous.
   - Compact, etc.
2. Crystalline.
   - Granular or phanero-crystalline.
   - Crypto-crystalline.
   - Porphyritic, (the above combined.)

Class II. Basis of Classification — The Structure of the Mass.

Massive.
Schistose.
Shaly.
Slaty.
Laminated, etc.

Class III. Basis of Classification — Coherence.

Tenaceous, firm, compact, etc.
Incoherent, friable, uncompacted, etc.

Class IV. Basis of Classification — Chemical Nature.

Silicious.
Calcareous.
Ferruginous.
Carbonaceous, etc.

Class V. Basis of Classification — Mineral Constitution.

Quartzose.
Micaceous.
Pyritiferous.
Garnetiferous.
Staurolitic.
Chloritic, etc.

Class VI. Basis of Classification — Lithological Character.

Granitic.
Basaltic.
Dolomitic.
Porphyritic.
Trachytric.
Dioritic, etc.

Class VII. Basis of Classification.— Origin.

Igneous,
Aqueous,
Metamorphic,
Pseudomorphic,
Eolian, etc.

B. NOMINAL.

Class I. Basis.— Physical Form of the Constituents, (Mainly.)

Conglomerates: { Pudding stone. Gravel, (incoherent conglomerate). Breccia.

Grit, grit-rock, sand, sandstone, sandrock.
Clay, mud, silt, earth, alluvium, soil,
Till,
Tufa, etc.

Or, again,

Crystallites,
Clastites,
Aggregites,
Amorphites.

The terms of the last named group may be defined as follows:
Crystallites, those rocks that are crystalline in structure;
Clastites, those which are fragmental or detrital in origin;
Aggregites, those which are simply accumulations of individualized particles of matter, coherent or incoherent, neither crystalline nor detrital in origin, as infusorial earth, or chalk, when it is composed of uncomminuted Rhizopod shells;
Amorphites, those rocks in which there are no discernible individualized constituents.

Class II. Basis of Classification.—Structure of the Mass.

Schist,
Shale,
Slate, etc.

Or, again,

Stratified,
Unstratified.

Class III. Basis of Classification.—The Crystalline Character of the Constituents.

Granite, (crystals distinct).
Granulite, (crystals minute).
Aphanite, (no visible crystals).
Porphyry, (crystals in compact base).

It is proposed to restore the term *granite* to a proper etymological use, and apply it to rocks consisting of distinct, crystalline grains of medium or large size, and to deprive it of mineralogical signification, making it a term denoting simply a certain class of crystalline aggregates.

It is proposed to designate minutely granular crystalline rocks, by the diminutive term *granulite*. *Aphanite* may then be more freely used to include all crypto-crystalline rocks, while *porphyry* will embrace combinations of the last with the two former.

Class IV. Basis of Classification — Physical Characters.

Trachyte.
Rhyolite.
Pumice.
Scoria.
Phonolite.
Buhrstone.
Pearlstone, etc.

Class V. Basis of Classification — Origin.

Lava.
Trap.
Meta (——.)
Igno (——.)
Aguo (——.)

There is a very prevalent, and, for the most part, just prejudice against the use of the name *trap*, arising from the frequent use of the term as though it conveyed a mineralogical signification, whereas the term really has none, and, in its proper application, includes rocks of various mineralogical and chemical constitution. But this abuse is really but an aggravated instance of what is common, indeed, almost universal, under the present system of nomenclature. To merely specify that a rock is granite, may be to use that term as a "cloak of ignorance" in the same sense, though perhaps not to an equal degree, as to rest with the assertion that a rock is a "trap;" for the term granite embraces a scarcely less wide range of minerals or of ultimate chemical constituents, and the wresting of the term from its primitive and proper application, is scarcely less violent. If, however, the term *trap* be stripped of all pretension to mineralogical signification, and confined to the simple designation of rocks formed of matter that issued through fissures, either constituting dikes, or spreading out into sheets, and so incidentally giving rise to step-like topography, as distinguished from *lavas* that have arisen from craters and flowed away in radial streams, with the attendant structural distinctions between the two, it will serve a convenient function in the literature of the subject, without being a "cloak of ignorance" in any other sense than *lava* is, or many other general, very convenient and necessary terms.

There will, doubtless, arise many cases in which it will be impossible to determine the method of issuance of a given igneous rock, and neither the term *lava* nor *trap* could be used in the restricted sense here proposed, and there may be little fundamental distinction between the phenomena in the two cases; but both the distinction and the terms are serviceable in geological literature, when stripped of the pretentious clothing to which they have no title.

Prof. Dana has suggested that metamorphic rocks be designated by the prefix *meta.* If this were generally adopted it would doubtless be serviceable; but the limitations of knowledge being such as they are, it would seem almost necessary to introduce a corresponding prefix to indicate similar rocks of igneous or aqueous origin. For if the simple name, as diorite for example, be understood to imply igneous origin, and the compound term, as meta-diorite, a metamorphoric one, it would be necessary, in the *very naming of the rock*, to assert an opinion as to its origin. But in many cases it is impossible to positively determine the origin of a rock, whose other characteristics may be very well known; and there would be no convenient term to express this knowledge, without implying knowledge not possessed. In respect to granite, for instance, it is contended, severally, by able geologists, that it may have an igneous, an aqueous, and a metamorphic origin, and yet, in many instances, the working geologist would not feel at liberty to assert that a given granite belonged to either class; and it would be a sore inconvenience to be obliged to make an implied assertion upon the subject, or else be shut out wholly from the use of the term granite. If, therefore, the system of introducing prefixes to designate origin be adopted at all, it should be complete, and yet leave the working geologist at liberty to use the fundamental term, free from the added signification.

It is hence suggested that the term *meta-* be used as a prefix, when it is desired briefly and conveniently to assert a metamorphic origin; that the prefix *igno-* be used similarly to assert an igneous origin; and *aquo-* in like manner, to imply an aqueous origin; while the simple terms shall have merely their own mineralogical, or other appropriate, signification.

Class V will then embrace the terms, lava and trap, used to designate rocks of certain special eruptive origins, and a long list of terms to which the prefixes *meta-*, *ingno-* and *aquo-* are attached to signify, respectively, metamorphic, igneous and aqueous origin.

The foregoing terms furnish fair, though somewhat inadequate, facilities for the designation of the several classes of properties indicated under the headings. There remains to be added a series of terms which shall express the mineralogical constitution of rocks, which is by far their most important characteristic. It is in respect to this that our present system is weakest, and, from the fact that it attempts to impose fixed names upon indefinitely varying aggregations, must necessarily ever remain unsatisfactory. It is, therefore, proposed to escape this difficulty by the use of a system of flexible compound terms, which shall admit of variation to express varying composition, and, roughly, the varying quantitative relations of the mineral ingredients. As above indicated, the growing tendency in lithological literature is toward the employment of compounds of mineralogical names. The advantage of this, in clearness and precision, as well as in the convenience of the reader, is manifest. But it results in cumbersome terms, and if carried sufficiently far to overcome the defects of the present system, becomes burdensome. This, however, may be obviated by a series of contractions which shall retain a significant portion of the mineralogical name, without the burden of its entirety. For the sake of euphonious combinations, these contractions may be varied somewhat in their several combinations. The following are suggested as available abbreviations of the names of the leading minerals that enter into the composition of rocks, and it will not be difficult to extend the list to any other minerals that may, in given instances, become prominent lithological constituents.

Abbreviations of the Names of Minerals Constituting Rocks.

Quartz — Qua., or qu.
Feldspar — Fel.
Orthoclase — Orth., or ortho.
Microcline — Micr., or micro.
Oligoclase — Olig., or oligo.
Labradorite — Lab., labra., or labrad.
Albite — Al., alb., or albi.
Andesite — And., or ande.
Nephelite — Neph., or nephe.
Leucite — Leuc., or leuci.
Sodalite — Soda., or sodal.
Mica — Mi.
Muscovite — Musc., or musco.
Biotite — Bio., or bi.
Hydromica — Hydrom., or hydromi.
Amphibole — Amph., or amphi.
Hornblende — Horn., or 'orn.
Actinolite — Act., or actin.
Smaragdite — Smar., or smara.
Tremolite — Trem., or tremo.
Pyroxene — Pyr., pyro., or pyrox.
Augite — Aug., or augi.
Sahlite — Sahl.
Diallage — Dial.
Hypersthene — Hypers., or hypersth.
Saussurite — Saus., or sausu.
Epidote — Ep., epi., or epid.
Garnet — Gar., garn., or garne.
Chrysolite — Chrys., or chryso.
(Olivine — Oliv., or olivi.)
Calcite — Calc., or calci.
Serpentine — Serp., or serpe.
Chlorite — Chlo., or chlor.
Pyrite — Pyri., or pyrit.
Magnetite — Mag., magn., or magne.

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Hematite — Hem., or hema.
Menaccanite — Menac., or menacca.
Tourmaline — Tour., or tourma.
Graphite — Graph., or graphi.
Apatite — Ap., or apa.
Andalusite — Andal., or andalu.
Cyanite — Cy., or cyan.
Sericite — Seri., or seric.
Zircon — Zir., zirc., or zirco.

In the combination of these it is suggested that the leading constituent stand first, and that the remaining constituents follow in the order of importance. In crystalline rocks there will often be present minerals in small and varying quantities, which it will be neither convenient nor desirable to include in the compound name of the rock, but which should be regarded, as they commonly are, as accessory minerals. There may be little philosophical basis for this distinction, since the rock is at best but an aggregate, and is what it is by virtue of the total aggregation, and not by virtue of any definite composition, as in the case of a mineral or chemical compound. Nevertheless, these minor mineral constituents do not, in the main, represent any distinctive condition in the formation of the rock, but rather some of those accessory circumstances common to a wide range of rock-formations. They are, therefore, geologically incidental, rather than essential, conditions, and their products may, therefore, be omitted from the compound name and classed as accessory minerals, and as such receive attention in exhaustive descriptions, without burdening the more general discussions. It will of course be within the discretion of each writer, in the case of a given rock, to decide what are its essential and what its trivial constituents.

In this system no uniform terminal syllable is proposed. It may be doubted whether lithologists will take kindly to this innovation, since it is at variance with the prevalent custom of terminating rock names with an *ite* or an *yte*, after the fashion of mineralogical terms. A grave objection to the usage, however, arises out of the very fact of this imitation, since it implies, in the rock-aggregation, something of the same definiteness of constitution that the mineral possesses; and this, I believe it is universally conceded, is a false and mischievous idea. It seems to the writer, therefore, best that the name should imitate the complex aggregation of the rock which it designates, rather than the individualized character of a mineral to which it has only the semblance, not the substance, of a true likeness. The first, therefore, of the following series of proposed names will consist of a bare aggregation of abbreviations of the names of the mineral constituents of the given rocks, in the order of their relative importance, thus both representing and defining the rock without pretension to individualization. The oddness of the names may at first be mistaken for uncouthness, which will indeed be justly chargeable in some cases, but the quaint elegance of other instances will offer some, if not full, compensation. The uniformity — not to say monotony — given by the fashionable suffix will be lost, but a vivacious variety will be gained.

An alternative series, however, is proposed, more in harmony with the present habit, both in respect to uniformity of termination, and the order of arrangement of the constituents, which is that of the inverse order of importance, the most abundant mineral being last and receiving the termination. The suggestion of Prof. Dana in respect to a distinctive orthography is here adopted.

The application of the system may be illustrated by the familiar rock granite. Its composition is generally stated as quartz, feldspar and mica. Assuming, for the moment, that no more precise statement is desired, and that the relative amounts of the ingredients are in the order given, its name under the first form of the proposed system will be qua-fel-mi (quàfelmi). If, however, as is very frequently the case, feldspar is the leading ingredient, and quartz second in order of importance, the name will be fel-qua-mi (fèlquami). Should mica stand second in importance, the formula would be fel-mi-qua (félmiqua , and so on for other variations. In this instance, mica rarely assumes the leading place without removing the rock from the present category of granites. But under the proposed system the nomenclature will strictly adhere to the mineralogical constitution and the compound terms mi-fel-qua (mi-felqua), and miqua-fel (miquafel), will represent the preponderance of mica in this mineral aggregation, and the structure will be represented by an appropriate adjective, as foliated mifelqua, or schistose miquafel, or miquafel schist, or otherwise, as the case may be.

But the mere indication that the granite is compossd of quartz, feldspar and mica, may be quite too general for precise discussions, since it does not indicate which feldspar, nor which mica, nor whether more than one of either or of both is present. The more precise of the text-book definitions of granite rarely go beyond the statement that it is composed of quartz, orthoclase and mica. If this is the degree of precision chosen to be asserted the new terms will be, qu'orth-mi (quórthmi), ortho-qua-mi (orthóquami), mic-ortho qua (mic rthoqua), qua-mic-orth (quámicorth), ortho-mi-qua (orthomiqua), or mi-qu'orth (miquórth), according as the relative proportions may be. But the mica, instead of being common muscovite, which would doubtless be understood by the general term, may be biotite. In this case the names will be qu'ortho-bio (quórthobio), ortho-qua-bio (orthoquábio), bi-orthoqua (bióŕthoqua), and so on, according to the relative proportions.

By modifications of the abbreviations which will not destroy their distinctive, representative character, difficult vocal combinations may, for the most part, be avoided, and euphonious terms secured. The system, it will be observed, is quite analogous to that adopted by chemists to meet the complexities of carbon compounds, but will rarely need to approach it in cumbersome combinations.

Under the alternative system proposed, similar combinations will result, but the order will be reversed, and the termination *yte* added to the leading constituent. When the usual order of naming the constituents of granite,—quartz, feldspar and mica—represents the relative abundance of the constituents, the name will be mi-fel-quartzyte (mifelquartzyte). This extension of the use of the the term quartzyte appears not unjustifiable when it is considered that, in addition to the preponderance of free quartz, silica forms a large constituent of the remaining ingredients; and that there is a not uncommon class of rocks, intermediate between the old classes quartzyte and granite, to which such a term would be happily applicable. But among the granites feldspar is often the leading constituent. The name will then be mi-qua-felsparyte (micafelsparyte). The more precise names will be mic-ortho-quartzyte), mi-qu'orthoclastyte (miquorthoclastyte), qu'ortho-micatyte (quorthomicatyte), qua-mic-orthoclastyte (quamicorthoclastyte), ortho-mi-quartzyte (orthomiquartzyte), ortho-qua-micatyte (orthoquamicatyte), bi-ortho-quartzyte (biorthoquartzyte), bioqu'orthoclastyte (bioquorthoclastyte), qu'ortho-biotyte (quorthobiotyte), qu'ortho-muscovyte (quorthomuscovyte), etc.

The foregoing, perhaps, sufficiently illustrate the method of the system, its extreme flexibility, and consequent adaptiveness to the variations of rock combinations, the self-definitiveness of the terms, and their monemonic advantages with students, as well as, on the other hand, something of the cumbersome complexity and quaintness which will sometimes arise where exact momenclature is attempted. In the following lists no attempt is made to exhibit the complete variation under the several rocks, but simply to give leading names under the two systems, assuming, usually, that the common order of naming the ingredients is that of their relative abundance. The verbal combinations that would arise with other proportions can readily be constructed.

Class V. Basis of Classification — Mineral Composition.

PRESENT NAMES.	FIRST PROPOSED FORM.	SECOND PROPOSED FORM.
Limestone..........	Limestone, or............	Calcityte.
Dolomite..	Dolomite	Dolomyte.
Quartzite...	Quartzite..	Quartzyte.
Granite	Qua-fel-mi, or............	Mi-fel-quartzyte, or
....	Qu'-orth-mi..............	Mic-ortho quartzyte.
....	Ortho qua-mi.............	Mi-qu'orthoclastyte.
... .	Qu'-ortho-bio............	Bi-ortho-quartzyte.
....	Qu' ortho-musc	Musc-ortho-quartzyte.
....	Ortho-qua-musc, etc......	Musc-qu'orthoclastyte, etc.
Granulite......... ..	Fel-qua, or	Qua-felsparyte, or
....	Qua-fel	Fel-quartzyte.
Gneiss	Foliated fel-qua-mi.......	Foliated mi-qua-felsparyte.
....	Foliated fel-mi-qua.......	Foliated qua-mi-felsparyte.
....	Foliated qua fel mi	Foliated mi-fel-quartzyte.
....	Foliated qua-mi-fel, etc...	Foliated fel-mi quartzyte, etc.
Mica schist.........	Schistose mi-fel-qua, or ..	Schistose qua-fel-micatyte.
....	Schistose miqua-fel	Schistose fel-qua-micatyte.
Hydromica Schist .	Schistose Hydro-mi-qua-fel, etc	Schistose fel-qua-hydromicatyte.
Protogine	Qu'-orth-michlor.........	Chlor-mic-ortho-quartzyte.
Minette	Ortho-bio	Bi-orthoclastyte.
Greisen	Granular-qua-mi	Granular mi-quartzyte.
Felsite	Felsit	Felsyte.

Class V. Basis of Classification — Mineral Composition — con.

PRESENT NAME.	FIRST PROPOSED FORM.	SECOND PROPOSED FORM.
Quartz-felsite	Felsi-qua	Qua-felsyte.
Leucitite	Leucitite	Leucityte.
Kersantite	Bi-olig	Oligo-biotyte.
Kinzigite	Bi-olig-'ar	Garn-oligo-biotyte.
Miascite	Micro-nephe-soda-bio	Bio-soda-nephe-microclinyte.
Ditroite	Micro nephe-sodal	Soda-nephe-microclinyte.
Syenite.	Orth-'orn, or	Horn-orthoclastyte, or
	Orth-amph	Amph-orthoclastyte.
Quartz-Syenite	Orth-'orn-qua, or	Qu-'orn-orthoclastyte, or
	Orth-amphi-qua	Qu-amph-orthoclastyte.
Syenite Gneiss	Schistose Orth-'orn	Schistose Horn-orthoclastyte.
Hornblende Schist	Schistose Hornblendite	Schistose Hornblendyte.
Amphibolite	Amphibolite	Amphibolyte.
Actinolite	Actinolite	Actinolyte.
Unakite	Ortho-qu'-epido	Epido-qu'-orthoclastyte.
Foyaite	Ortho-neph-'orn	Horn-'eph-orthoclastyte.
Diorite	Alb-(h)orn, or	Horn-albyte, or
	Horn-alb	Alb-hornblendyte.
	Labrad-(h)orn	Horn-labradoryte.
	Olig-(h)orn, or	Horn-oligoclastyte, or
	Horn-olig	Olig-(h)ornblendyte.
	Anorth-'orn, or	Horn-anorthyte, or
	Horn-anorth	Anorth-'ornblendyte.
	(Amphi-lab)	(Lab-amphibolyte).
	(Amph-anorth)	(Anorth-amphibolyte)
Quartz Diorite	Alb-(h)orn-qua	Qu' 'orn-albyte.
	Horn-albi-qua	Qu'-alb-hornblendyte.
	Olig-(h)orn-qua	Qu'-'orn-oligoclastyte.
	Horn-oligo-qua	Qu'-olig-hornblendyte.
Andesite	Andesite, or	Andesyte.
	Ande-horn	Horn-andesyte.
Dacite	Ande-horn-qua	Qu'-orn-andesyte.
Corsite	Anorth-'orn	Horn-anorthyte.
Euphotide	Saus-'mar, or	Smara-sausuryte.
	Saus-dial	Dialli-sausuryte.
Gabbro	Labro-dial, or	Dial-labradoryte.
	Dial-lab	Labro-diallagyte.
Augitic-andesite	Ande-aug	Augi-andesyte.
Norite	Labra-pyr	Pyro-labradoryte.
Hypersthenite	Labr-yperth	Hyperth-labradoryte.
Dolerite	Labrad-aug, or	Augi-labradoryte.
	Labr'-aug	
Diabase	Lab ad-aug, or	Augi-labradoryte.
	Labr' aug	
Eucrite	Anorth-aug	Augi-anorthyte.
Amphigenite	Augi-leuc	Leuci-augyte.
Nephelinite	Augi-neph	Neph-augyte.
Eclogite	Horn-garni-smar	Smara-garni-hornblendyte.
Epidosite	Epido-qua.	Qu'-epidotyte.
Eulysite	Chryso-dial-garn	Garne-diallo-chrysolyte.
Picrite	Chrys-aug.	Augi-chrysolyte.
Ophiolite	Serpe-calc	Calc-serpentyte.
	Serpe-dol, or	Dolo-serpentyte, or
	Serpe-mag	Magne-serpentyte.

In pronunciation, the accent should be placed upon such syllables as will best retain the original sounds of the abbreviations, so far as convenience of utterance will permit.

Since a gradual transition, advantageous at all stages, is to be preferred to a sudden revolution, it is suggested that the new terms may be introduced in lithological discussions in parenthesis after the usual names. The new terms will thereby not merely serve as definitions of the old as used, but as succinct statements of the composition of the special rocks described, which is often but vaguely indicated by the common names. This will often permit a shortening of descriptions, and will certainly foster precision of observation and statement, while (if a brief explanation of the system and a list of abbreviations are given until they become well known) it will greatly serve the convenience of students, semi-scientific readers, and not a few geologists who may not be specialists in lithology and freshly familiar with its terms. The system would thus have opportunity to perfect itself while growing into general use.

WATER PUPPY.

(*Menobranchus lateralis say.*)

BY P. R. HOY, M. D.

DESCRIPTION.

Entire length of large female 14 inches. Head 2 inches long and 1¾ broad. Body, including head, to vent, 10 inches. Tail 4 inches to vent; breadth of tail, 1¾. The male smaller, from 10 to 11 inches in length. Head large, flattened above. Snout truncated. Eyes small, placed far apart. Nostrils lateral, near the margin of the upper lip. Two rows of small teeth in the upper, and one single row in the lower jaw. Mouth large. Lips fleshy. Tongue broad, entire, free at the point. Neck contracted and provided with a deep cutaneous fold at the throat. Three rows of external plumose gills on each side, they are placed on the posterior margin of a corresponding fleshy prolongation, and supported by three branchial arches between which there are two gill openings into the mouth somewhat fish like. Body elongated and stout, covered by a soft skin, permeated by many pores. Tail broad, flattened, emarginated eel-like. Feet four, all have four toes each without nails, vent a longitudinal fissure. Color light brown, with numerous dark spots and blotches, beneath lighter, with fewer and smaller spots. Heart two-chambered. Lungs rudimentary, *not functional.* Eggs large and much like those of fish. This species of menobranch inhabits large rivers and lakes in the northern states, especially numerous in Lake Michigan. They feed on small fish, crustaceans and molusks. They frequently commit depredations on the spawning beds of fish, and thus doing considerable damage.

They inhabit rather deep water with stony bottom, over which they crawl in search of prey. They seldom, or never rise to the surface. They swim with considerable velocity, however, when occasion requires. They take the baited hook, and dire is the consternation of the boy who hooks the fish with legs. I have little doubt that the flesh is well flavored and nutritious; certainly it is true that when a cat once gets a taste of the flesh of the water puppy it is well nigh crazy to repeat the experiment In nature the menobranchus occupy nearly the lowest place among Amphibians, which class stands between fish and reptiles. Physiologically they are fish having legs in place of fins, if such a monstrosity could be admitted in *fish aristocracy!* They cannot live out of water as long as some other fish, for the reason that the gills are exposed and dry more readily in consequence. If the body is kept moist life is sustained for a greater length of time, proving that aeration is, to a slight degree, carried on through the skin.

It is an interesting fact that the early tadpole stage of salamanders resemble the adult menobrach. In early life the Amblistoma lurida — the life history of which I have carefully studied — is strictly aquatic, has a tricamerate heart and rudimentary lungs. However, when the legs and feet are being developed the gills begin to wither and the lungs to assume functional duty, imperfect as yet though it may be. The second auricle to the heart is now being developed in this transition stage. In this condition the young salamander has been considered a privileged animal — that while in water branchial respiration was sufficient, and again, when on land pulmonary respiration was all sufficient — a perfectly amphibious animal. But we may withhold our admiration of this privileged condition, for in fact it cannot live in, or out, of water, the gills being partly absorbed, while the yet imperfectly developed lungs render aerial respiration quite imperfect. So the poor animal has to come to the surface for a mouthful of air and plunge back into the water in order thus to secure the full benefit of the imperfect gills; so they have to play at shuttlecock from one element to the other, not being able to live in either element alone. I am persuaded that the central organ of the circulation (the heart) indicates the mode of respiration, as no air-breathing vertebrate has less than three chambers in the heart, and no aquatic vertebrate has more than a two-chambered heart. Now as the menobranch cannot live out of water — is strictly aquatic — has only branchial respiration — reason sufficient to prove that they are provided with a bicamerate heart. On dissection we found the two-chambered heart, as anticipated. In studying the salalemanon I found when a leg was amputated it would be reproduced in precisely the same manner — toes appeared in like order, as in the original development. But if a branch of the gill was removed it was not reproduced, for the reason, it would seem, that the gills were only a temporary organ, only to serve the animal during its embrionic state, while if the feet were to serve the animal through the adult state, their reproduction became a necessity. But, we anticipate, when we clip off a portion of the gills of the menobranch, those portions amputated, that portion was reproduced promptly, so that in three weeks the gills were again perfect. The gills being essential to adult life, they were restored. The water puppy is a most beautiful object, as it appears in its favorite surroundings, with the long scarlet plumose gills, continually waving backwards and forwards. The behavior of the menobranch when confined in an insufficient quantity of water is interesting. As the oxygen becomes exhausted, the animal rises to the surface, opens the mouth and takes in a portion of air, bubbling it out through the gill openings, thus bringing a portion of air in contact with the gills, or rather by this movement the water is aerated, near the surface, precisely as do fish in similar circumstances. I have frequently seen puddles of water, where the mud fish, *melanura limi*, abounded, entirely covered with small bubbles formed by these hardy fish in their partially successful efforts to obtain a sufficient amount of oxygen.

THE PIPESTONE OF DEVIL'S LAKE.

(Read before the Wisconsin Academy of Sciences, Arts, and Letters, February 14, 1877.)

By E. E. Woodman, Baraboo.

A rock found in the vicinity of Devil's Lake has not, so far as I am aware, been properly classified. The local and popular name for it is soapstone, derived, doubtless, from several qualities which it possesses in common with steatite, and especially the greasy feel of that mineral. From the presence of the elements of soapstone it is talcose, but the primary object of the present paper is to identify it as an argillite of the variety called pipestone.

Two specimens are herewith presented. The red one is from the widely known quarry in south-western Minnesota, the other from the neighborhood of Devil's Lake, Sauk county, Wisconsin. On a superficial examination they will be found to possess several properties in common. In their feel, hardness, susceptibility to polish, earthy odor when moistened, freedom from grit, in most of their obvious properties except color, they agree. Also their behavior before the blow-pipe is the same, both being infusible without a flux, but with borax yielding a green glass. In these characteristics they answer to the description which Nicollet (Itinery 1842, Senate Document No. 237) gives of the red pipestone of Minnesota, as quarried under his personal direction and observation: "Compact; structure slaty; receiving a dull polish; having a red streak; color blood red, with dots of a fainter shade of the same color; fracture rough; sectile; feel somewhat greasy; hardness, not yielding to the nail; not scratched by selenite, but easily by calcareous spar; specific gravity 2.90. The acids have no action upon it; before the blow pipe it is infusible *per se*, but with borax gives a green glass."

I am indebted to Prof. W. W. Daniells, of this Academy, for a qualitative analysis of these specimens which completes the evidence of their identity. He finds the principal component of each to be silicate of alumina. This is combined with small percentages of lime, magnesia and oxide of iron, the last being a larger constituent of the red than of the gray specimen, as might be inferred from its color. The specific gravity of the red specimen is by his determination 2.752; and of the gray one, 2.829. The agreement in this regard also is quite close, though perhaps accidental; for Nicollet's determination of 2.90 for the red variety shows that specimens from the same quarry may vary considerably in this particular; and so, likewise, they do in color. The stone from the Minnesota quarry is not uniformly of the blood-red color on which the species *Catlinite* is founded, but often is mottled with lighter shades of red, running into yellow; while that from Devil's Lake, as thus far discovered, is all variegated, gray, black, yellow and red being intermingled in the same specimen, producing the veined appearance of some marbles. One part of the gray specimen here submitted gives a red streak undistinguishable from that of the red specimen, and I have seen specimens from Devil's Lake in which the dark color greatly predominated, though such examples are as yet rare. This diversity in weight and color indicates that a quantitative analysis of specimens from different sources would be scarcely more valuable, as a means of identification, than a qualitative one. I however take from *Silliman's Journal*, 1839, the only analysis to which I have access, that of the Minnesota pipestone, by Dr. Jackson of Boston:

	Grains.
Water	8.4
Silica	48.2
Alumina	28.2
Magnesia	6.0
Perox. Iron	5.0
Ox. Manganese	0.6
Carb. Lime	2.6
Loss (probably magnesia)	1.0
	100

The carbonate of lime is not an essential ingredient, but is mixed in fine particles.

It will be noticed that this formula agrees, in the general way, with the qualitative results by Prof. Daniells.

I was led to conjecture the true character of this rock from an examination, made in 1869, of the quartzite of the falls of the Big Sioux, in Dakota Territory, where the town of Sioux Falls has since been built. That outcrop is reported to be the same with the formation containing the pipestone of Minnesota, only forty miles distant, and is identical in its aspects with the quartzite of Devil's Lake. It has the same color, hardness, completeness of metamorphism, ripple marks, and tendency to degrade in cubical forms; the last a notable feature of the rock at Devil's Lake and equally characteristic of the quartzite in which the Catlinite is found, as it is described by Nicollet. These localities have not only the quartzite apparently identical, but also the pipestone. I found a mottled, yellow and red pipestone cropping out at the Big Sioux, associated with the quartzite. A fourth location of the pipestone, noted by Nicollet and later by Owen, is at the head waters of the Cedar, a tributary of the Chippewa, on Sec. 27, T. 35 N., R. 10 W., of the public survey, as I am informed by the owner of the land, Mr. H. C. Putnam of Eau Claire. Here, too, it is associated with quartzite.

The concurrence of these facts suggested to me the importance of identifying the talcose beds of Devil's Lake with the pipestone of the other localities. Pipestone is a rare rock. Its appearance in these widely separated centers, with like associations, I take to indicate a common age and origin for the containing quartzites, respecting which there has been much discussion and still exists a diversity of views. It would seem to have been satisfactorily determined by Prof. Irving that the quartzite of Devil's Lake is older than the Potsdam sandstone. The junction of the quartzite with the inferior formation has not been discovered in any of the localities herein mentioned. That evidence would be conclusive of the question in the particular case. While awaiting it, some authorities refer the Minnesota and Dakota formation to the Potsdam and others to the Huronian period. My thought is, that whatever the age of one of these formations, all are referable to the same epoch; that they are allied by the pipestone; and that this connecting link establishes the probability that these rocks are the result of the same cause or set of conditions, operating in that dawn of the continent's history when literally the dry land first appeared.

In the vicinity of Devil's lake the pipestone is found in but few places, and the exposure is nowhere extensive. It conforms to the Minnesota and Dakota outcrops in the thinness of the beds. The stratum from which the specimen herewith submitted was taken is perhaps eight inches thick, intercalated between heavy layers of quartzite, and was uncovered in the course of excavating a railroad borrow-pit. As quarried it is quite brittle, so that large pieces are obtained with difficulty. It hardens considerably as the moisture dries out. If an exposure should be discovered in which the stone was cheaply accessible over a considerable area, it would possess a commercial value for the ornamental uses which will readily suggest themselves to one who examines a dressed specimen. The stone has been somewhat used as a material for tobacco pipes by present residents of the locality, but no systematic effort to utilize it has been made, for the reasons indicated. Shortly before I was at Sioux Falls, then Fort Dakota, some white men had poached upon the Minnesota pipestone reservation to their considerable profit, it was said. They set up turning lathes at the Fort, and, transporting supplies of the red stone from the quarry with teams, applied machinery to the manufacture of the calumet, which they modeled upon the Indian hand-made article. They shipped the finished product to some military post on the upper Missouri by a supply steamer, and there bartered it with the red men for pelts and skins, to the great advantage of both parties possibly, and of the whites probably, if not certainly.

THE LARGER WILD ANIMALS THAT HAVE BECOME EXTINCT IN WISCONSIN.

(Read at the Racine meeting.)

BY DR. P. R. HOY.

A record of the date and order in which native animals become extinct within the bounds of any country is of present interest, and in the future may be perused with redoubled satisfaction.

Fifty years ago the territory now included in the state of Wisconsin was nearly in its primitive condition. Then many of the larger wild animals were abundant. Now all has changed; the ax and plow, gun and dog, railway and telegraph, have completely metamorphosed the face of nature. Not a few of the large quadrupeds and birds have been exterminated or have hid themselves away in the wilderness of northern Wisconsin.

There was a time, away back in the dim past, when the mastodon, ox, elephant, tapir, peccary, and musk-ox roamed over the ancient prairies of Wisconsin, but now only their bones, from time to time, are exhumed and thus exposed to the wondering gaze of the ignorant many and the trained eye of the wiser few. We shall at this time, however, confine our attention to the historic period.

The antelope, *Antilocarpa Americana*, now found only on the western plains, did, two hundred years ago, inhabit Wisconsin as far east as Lake Michigan. In October, 1679, Father Hennepin, with La Salle and party, in four canoes, coasted along the western shore of Lake Michigan. In Hennepin's narrative he says: "The oldest of them" [the Indians] "came to us the next morning, with their calumets of peace, and brought some *wild goats*." This was at or near Milwaukee. "Being in sore distress, we saw upon the coast a great many ravens and eagles, from whence we conjectured there was some prey, and having landed on that spot we found above the half of a fat wild goat which the wolves had strangled. This provision was very acceptable to us, and the rudest of our men could not but praise the Divine Providence which took so particular care of them." This was, undoubtedly, near Racine. "On the 16th" [October 16, 1679] "we met with abundance of game;

a savage we had with us killed several stags and *wild goats*, and our men a great many turkey, very fat and big." This last point was between Kenosha and Racine. Hennepin's goats were without doubt antelopes. Father Joliet, a little earlier, mentions that "on the Wisconsin there are plenty of turkey cocks, parrots, quails, wild oxen, stags and wild goats." All species of the deer family were called stags by the early travelers. Schoolcraft mentions antelopes as occurring in the Northwestern Territory, and as late as 1850. Antelopes were not uncommon in southern Minnesota, only forty miles west of the Mississippi river. It is evident, then, that antelopes have retired quite leisurely.

When the last buffalo, *Bos. Americana*, crossed the Mississippi is not precisely known. Governor Dodge told me that buffalo were killed on the Wisconsin side of the St. Croix river the next year after the close of the Blackhawk war, which would be 1833. So Wisconsin had the last buffaloes east of the Mississippi river.

The Woodland Caribon, *Rangifer Caribou*, were probably never numerous within the limits of the state. A few, however, were seen near La Point in 1840 ; none since.

Elk, *Cervus Canadensis*, were on Hay river in 1863, and I have but little doubt that a few still linger with us. The next to follow the buffalo, antelope and reindeer.

Moose, *Alce Americanus*, continue to inhabit the northern part of the state, where they still range in spite of persecution. A fine cow moose was shot near the line of the Wisconsin Central Railway in December, 1877.

A few panthers, *Felis Concolor*, are yet with us; a straggler is occasionally seen. Benjamin Bones of Racine shot one on the head-waters of Black river, December, 1863.

Wolverines, *Gulo luscus*, are occasionally taken in the timber; one was taken in La Crosse county in 1870.

Of beaver, *Castor Canadensis*, a few still continue to inhabit some of the small lakes situated in Lincoln and adjacent counties.

The badger, *Taxidea Americana*, is now nearly extinct in Wisconsin. In a few years the only badger found in the state will be the one on the coat of arms.

The opossum, *Didelphis Virginiana*, were not uncommon in

Racine and Walworth counties as late as 1848. They have been caught as far north as Waukesha, and one near Madison in 1872, since which time I have not heard of any being taken. I am told that a few are still found in Grant county. They will soon be exterminated, no doubt. The last wild turkeys, *Meleagris Gallopavo*, in the eastern part of the state, was in the fall of 1846, at which time a few were discovered near Racine. They were hunted with such vigor that the entire number were shot, "The last of the Mohicans." I am told, by Dr. E. B. Wolcott, that turkeys were abundant in Wisconsin previous to the hard winter of 1842–3, when snow was yet two feet deep in March, with a firm crust, so that the turkeys could not get to the ground; they hence became so poor and weak that they could not fly and so were an easy prey for the wolves, wildcats, foxes and minks. The Doctor further stated that he saw but one single turkey the next winter, and none since. One was shot in Grant county in the fall of 1872. Possibly there are a few yet to be found in this large southwestern county; if not, then wild turkeys are exterminated in the state of Wisconsin.

OBSERVATIONS ON THE RECENT GLACIAL DRIFT OF THE ALPS.

BY T. C. CHAMBERLIN, A. M., PH. D., STATE GEOLOGIST.

The drift formation of our state forms an important feature of its geology, and, owing to some peculiarities of its development, perhaps more than ordinary interest attaches to it. I therefore zealously embraced the opportunity which a visit to Switzerland afforded of observing the drift deposits formed by the glaciers of the Alps.

Observations were made upon the deposits of the Bossons, Bois or Mer de Glace, Findelin, Gorner, Viesch, Aletsch, Rhone, Unter Aar, and the upper and lower Grindewald glaciers, and, casually, as many more.

It was my endeavor to use the limited time at my command to as great an advantage as possible by confining my attention to those features which are most analogous to our drift; the more so, because it is most difficult to gather exact and definite descriptions of this phase of glacial phenomena from most accessible writings on the subject, and naturally enough so, because the glaciers themselves and their surface moraines present so much more conspicuous and absorbing objects of interest.

My observations will, therefore, have value, if they have value at all, not because of their fullness and completeness, for they do not approach to that, but because they were made from this standpoint, and because they have been brought to the standard of the same mental meter with our own deposits; and whether that meter be standard or otherwise, it is hoped that, with some corrections for mental temperature, it has measured alike in both cases.

It is essential, at the outset, to clearly discriminate between the products that arise under those conditions which are peculiar to Alpine situations and those that are more specifically due to glacial agency without regard to special local circumstances; and hence a few explanatory words, antecedent to the observations themselves, may be appropriate.

In the majority of cases, Alpine glaciers occupy narrow steep valleys which afford them little opportunity to deploy as they undoubtedly would in more open ground, where they might present phenomena analogous to those of continental or arctic glaciers; but in some cases, they terminate, or have recently done so, in broader and less sloping portions of their channels, and thus furnish some very valuable hints as to the probable action of broad glaciers on less sloping floors.

Alpine glaciers derive the material of their deposits from two general sources, and their debris is correspondingly divided into two general classes, 1st, that which falls upon them from above, and 2d, that which they abrade from the rocks over which, or against which they move. The first class is borne passively *on* the ice stream, while the second is pushed or rolled along *beneath* it. The first is due to the accident of the glacier's position, the second is the direct result of its own action. The first class is only present when the glacier originates among towering peaks or flows along precipitous slopes; the latter presumably is always present. At the edges of the glacier the two classes often mingle, and undoubtedly some of the surface debris finds its way to the bottom through crevasses and moulins, so that the material carried along beneath the glacier is greater than it would be but for the surface burden; but, for the purposes of our study, this is unimportant. It is imperative, however, that we distinguish between the superficial and basal debris, as the former can have little or no representative in so plane a region as that covered by our drift, and can therefore throw no light upon its origin. This distinction is very easily made, for the most part, in the case of the Alpine glaciers mentioned; for the surface material is almost wholly unworn and angular, while the basal portion is usually abraded and rounded in greater or less measure.

The surface material forms in lines along the sides of the ice stream, where it has fallen from above, constituting lateral moraines; and where two streams unite, two of these lateral moraines are brought together and form a line along the middle of the joint stream, constituting a medial moraine.

To the rock rubbish borne along beneath the glacier, the term ground moraine, or *moraine profonde*, is applied.

So far, all is clear. So long as the glacier itself is present bearing lateral moraines on its sides, medial moraines on its surface and a ground moraine at its base, there is no room for confusion. But this detrital material at length reaches the end of the glacier and is deposited; and here arises something of confusion in the deposit itself, and something of confusion of ideas respecting it, or at least, a want of accurate and precise use of terms. The phrase terminal moraine is used to designate accumulations formed at the extremity of the glacier. But, setting aside the terminal deposits arising from the dropping of the lateral moraines, which remain somewhat distinct, it is evident that the medial moraine will be dropped upon the ground moraine at the foot of the glacier, and that this will occur under three conditions that ought to be distinguished. First, the foot of the glacier may be retreating, as is the case at present, because the melting is more active than the onward flow of the ice. Under these circumstances, the withdrawal of the ice leaves the medial moraines as a ridge, or line of debris, lying on the sheet-like ground moraine, and their relations remain essentially the same as before, save that the glacier has vanished from between them. In this instance the terms medial and ground moraines may still be used appropriately to designate them.

Secondly, the foot of the glacier may be stationary, in which case the material of the ground moraine, pushed along beneath, will accumulate at the glacier's margin in the form of a ridge, and the medial moraines will pile up in heaps on this. To call this simply a terminal moraine is not to speak very discriminately; for, in addition to the complexity of its own formation, it is liable to be confused with that which arises under the third condition, viz.: that in which the foot of the glacier is advancing.

In this case the glacier is not only discharging material from its surface and bearing it along its base, but it is plowing up that previously deposited in its pathway.[1] The result of this is the formation of a ridge at the foot of the ice plow, as in the previous case, but of more irregular character in respect, at once, to material, structure, and surface configuration. This is a terminal

[1] A portion is also overridden by the glacier.

moraine in a more significant sense than the preceding, in that it was not simply accumulated at the foot of the glacier, but was formed by its mechanical agency; and in that it marks the termination of a given glacial advance.

It would appear to be much in the interest of precision of thought and expression to confine the phrase "terminal moraine" to accumulations produced by a glacial advance, and to employ some other term, as peripheral moraine, for ridge-like accumulations due to halts in the retreat of the glacier; while the term "ground moraine" should include the wide-spread, sheet-like deposits of retreating glaciers. Our classification of morainic accumulations would then stand:

I. SUPERFICIAL MORAINES.

(*a*) *Due to local environment and passive glacial agency.*

(*b*) *Characterized by angular material.*

1. Lateral moraines.
2. Medial moraines.

II. BASAL MORAINES.

(*a*) *Independent of local environment and due to active glacial agency.*

(*b*) *Characterized by worn material.*

1. Ground moraines (sheet-like).
2. Peripheral moraines.
3. Terminal moraines.

Besides the glacial accumulations, we have constantly to deal with the associated torrential and other aqueous deposits formed by the abundant glacial waters, but these may usually be distinguished by structural characters.

The following observations relate to individual features of drift phenomena, and will be found more or less disconnected, and the paragraphs are arranged without much reference to logical sequence of thought:

1. The Rhone glacier surpasses all others visited in its instructiveness in relation to drift deposits. After a course of nearly 15 miles, it descends precipitously, like a gigantic frozen cascade, into a valley of the Rhone, where it finds a broader area and

more gentle slope. Here its foot spreads out into a flat semicircular form not altogether unlike an equine hoof.

The first point of special interest to be noticed is that the crevasses in this flat portion diverge in curving lines from the axis of the glacier toward the expanded margin. This I believe to be correlated with a divergent motion of the ice by which the expanded foot was formed; and in this I find a close analogy to the divergent motion of the ice of our own ancient Green Bay glacier, as shown in my recent report. The valley of the Rhone just below this is covered with drift, so that the striations, which it might be presumed to have made in its recently more expanded condition, are concealed, but at the foot of the Glacier de Bois, in the Chamouni valley, a divergence in striation amounting to about 75° was observed.

2. The Rhone glacier is now retreating at a somewhat rapid rate. With commendable regard for the interests of science and the profit of transient students, the successive positions occupied by the retreating foot of the glacier, each year since 1874, have been marked by lines of tarred bowlders and cairns. The method and rate of retreat is thus mapped out on the face of the valley itself. It will be sufficiently near for our purposes to say that the average retreat since 1874, has been about fifty paces per year. It therefore presents a fine opportunity to observe the deposition of a receding glacier, and, as it bears but little detritus on its surface, its abandoned ground moraine is well exposed for study. However, certain portions of the plain have been swept by glacial floods, which have somewhat modified the deposit, and care should be taken not to confuse the two deposits. A little close observation will show that in the portions recently abandoned by the glacier, and that have not been washed by the issuing waters, the bowlders frequently bear, perched upon their tops and slopes, sand, pebbles, and small fragments of rock. It is hence evident that they have never been swept by even the gentlest stream, and that no assorting or modifying action of any kind has been brought to bear upon them since they were abandoned by the ice. Furthermore, we may go to the foot of the glacier and see them slowly issuing, thus crowned, directly from the ice.

The ground moraine here consists mainly of rounded and scratched bowlders, gravel and sand, with but little clay, and only a small proportion of angular blocks that cannot be traced distinctly to the medial or lateral moraines. The surface contour is slightly, though not conspicuously, ridged. The more abrupt side of these little ridges is toward the glacier and their trend is in the main approximately parallel to the edge of the glacier, though sometimes notably oblique. This relationship suggested that they might be due to annual oscillations of the glacial margin. There is also discernable a feeble tendency of the material to arrange itself in heaps and ridges parallel to the lines of movement of the ice.

3. If we now approach the foot of the glacier, we shall find this moranic sheet of detritus passing without notable change or interruption beneath the ice. The appearance is as though a stationary mass of ice had formed on the surface of a bed of bowlders and gravel and was now quietly melting away. More critical examination would, of course, show that any given particle of ice was advancing. The edge of the glacier is thin and sloping and we may walk directly up on it. The edge seems to rest lightly upon the drift below. This last is not a mass of debris frozen together, or imbedded in the base of the ice — although individual bowlders are — but an independent underlying bed of bowlders, and finer material and open interspaces. These observations of course relate to the immediate edge of the ice. Some of the crevasses enable us to see a short distance farther in, where the same condition prevails. An artificial tunnel, styled an ice grotto, shows the same through a break in the ice.

The marginal portion of the glacier rests, so far as could be ascertained, not upon the bed rock, but upon its own basal moraine. How thick this bottom accumulation was, I had no means of ascertaining, but from the configuration of the valley, I should judge it was considerable.

4. The surface contour of the ground moraine seems to some extent to take shape beneath the glacier. At one point I observed a diminutive hillock, about six feet high, half enclosed in the edge of the ice, which was here nearly vertical. The appearance was

as though the ice, in its withdrawal, had half disclosed a mound lying beneath it. This, though a mere mound, was about equal in height to the adjacent heaps that had been left by the glacier.

5. At other points, near the center of the valley, the ice may be seen resting directly upon well assorted, stratified sand and gravel. Level sheets of fine detrital matter extend without disturbance of continuity or surface beneath the edge of the glacier. The assortment and stratification of this material was apparently accomplished by sub-glacial streams, which seem afterwards to have found other avenues, when the ice occupied their place, either by settling down from above, or advancing from behind. The singular fact is that the stratified sands should not have been disturbed. It is very likely true that these fragile formations near the edge of the glacier are heated by conduction from the warm earth surrounding, and by transmission through the comparatively thin ice above, and that they are thus enabled to protect themselves from the forcible action of the ice, by melting it as fast as, in its slow motion. it is pressed upon them.

6. If we now turn to the sides of the valley, we shall see that up to a certain height they are mainly bare of vegetation and present a fresher and less weathered surface than the slopes above, as though the glacier had recently stood at that hight. If we glance down the valley, we shall see that the upper margin of this surface descends curvingly, much like the contour of the present foot of the glacier. If we descend the valley to the point where this reaches the plain, we shall find the ground moraine rising into a low, irregular ridge, which stretches in a broken curve across the valley. The material of this ridge is essentially the same as that of the ground moraine, save that there is noticeably more sand and gravel in proportion to the coarse material, and the whole is more thoroughly rounded. These remarks relate to the surface material. The superficial contour, however, assumes quite a different and distinctive aspect. Although but a diminutive ridge itself, not perhaps exceeding twenty feet in height, its surface contour, instead of presenting a simple curving outline, exhibits a complex series of still more diminutive ridges, hills and hummocks, of irregular outline and arrangement, accom-

panied by correspondingly irregular depressions, some of which are filled with water and form miniature lakelets. The irregular outline and little islands of one of these made it almost a Lilliputian Minnetonka. Bowlders are abundant in all positions on and in the ridge, as shown by the sections exposed by the outflowing streams, which also exhibit the confused unstratified condition of the interior. Locally, there are small patches of stratified material. This ridge is most abrupt on the outside, or that away from the glacier, while on the inside it graduates, without any distinct line of definition, into the bowlder sheet above described.

This ridge presents a striking similitude to our Wisconsin Kettle moraine, and I think it may be safely said to be a miniature representative of the same phenomena.

This is a true terminal moraine, according to our definition, formed by an advance of the Rhone glacier.

7. A few rods — perhaps 20 — below this there is another moraine of like character, but of older date, as shown by the grass and shrubs that have grown upon it, as well as by its position and less angular contour. It is narrower and more simple in form than the preceding, and like it, is interrupted by level passes, the channels of former streams.

About 30 rods below this is a third, still less continuous, a good illustration of an interrupted, half destroyed moraine.

8. Between these three moraines are level gravel flats of fluviatile origin, and doubtless stratified.

9. On the south side of the Rhone, the middle moraine breaks up into an area of scattered mounds or "knobby drift."

10. On that side also, at the foot of the acclivity, where the solar action is less effective than elsewhere, a considerable mass of ice has been left by the retreating glacier, and this is much covered by sand, gravel and coarse detrital matter. As the ice melts, it deposits its burden of rock-rubbish in an irregular, hummocky fashion, somewhat resembling that of the moraine above described, but without the ridgey characteristics of the latter. It is mainly interesting as illustrating the form of deposition of a superficial glacial accumulation where the ice lets it down by melt-

ing from beneath, instead of casting it over its extremity in the usual method.

11. The south side of the Rhone also presents a fine exhibit of fluviatile silt, sand and gravel flats, and shows the pre-eminent tendency of glacial streams to wander widely, back and forth, across their valleys, when the slope is moderate, owing to the unusual rapidity with which they fill up their channels by the large burden of glacial mud, sand and gravel that they carry, or roll along their beds. They thus rapidly accumulate broad stratified sheets. I suspect that some deposits formed in this way during the Quaternary age have been mistaken for lacustrine formations, owing to their breadth and extent.

12. None of the other glaciers visited terminate in a manner equally favorable to the observations sought, but some of them present particular features of equal interest. The terminal moraines of the Grindenwald glaciers are even more instructive by way of comparison with our drift moraines, because of the closer proximity of the successive ridges, and greater similarity of the material, it being a limestone bowlder clay, with some metamorphic erratics included, and some assorted detritus. Some of the moraine ridges are a pronounced bowlder clay, while others are largely composed of bowlders or gravel. On the inner moraine of the upper Grindenwald glacier, there is much fine gravel and sand in heaps and miniature ridges, presenting a very interesting phenomenon. The outer range is more massive than those of the Rhone glacier, and is very strikingly similar to the Wisconsin Kettle moraine in its superficial expression. The corresponding moraines of the lower Grindelwald glacier show the same features very neatly, and those of the Bois and other glaciers display like characteristics.

13. So far as my observations went, the nature of the rock over which the glaciers passed was more influential in determining the proportion of clay, sand, gravel and bowlders, than I had supposed. Where the rock was mainly granitic, the amount of clay was proportionately small, the detritus being mainly coarse sand, gravel and bowlders. This was doubtless due to the difficulty of reducing the hard constituents of granite to powder. Where the

glacial channel lay through schistose rocks, or limestone, there was a notable larger proportion of clay, and some of the moraines were a typical bowlder clay. These observations throw unexpected light on the drift of our state, where there is a very marked difference between the glacial deposits of the limestone and granitic districts in respect to the physical condition of the material.

14. In former times, the Alpine glaciers were greatly expanded and stretched entirely across the lake region to the foot of the Jura mountains, on the French border. In this expanded condition, they most nearly, though still quite inadequately, represent the nature of American Quaternary glaciers. The Juras and much of the intermediate region are composed of limestone strata. To the west of Lake Neuchatel the sheet of drift extends up the mountain slope nearly 3,000 feet above the lake surface, when it terminates on the declivity in a rude, imperfect terrace of undulatory surface. This, where I observed it, is composed of bowlder clay, usually quite gravelly, and associated with gravel beds. It was my hope to find the margin of this great *moraine profonde* at some point on a comparatively level tract, where its development would not be cramped or coerced by encompassing barriers, but both at this point and in the vicinity of Gex, west of Geneva — the only two points where I was able to examine it — I found it pushed high up on the steep side of the mountains, and could, therefore, only conjecture what its form and structure would have been on plains similar to those of the Mississippi valley; indeed we can hardly assume that its material would have remained precisely the same, since in more level regions it might have been influenced in a greater degree by glacial waters. As it was, it may be characterized as a gravelly bowlder clay, with accompanying gravel beds.

15. In the beautiful valley of Ruz, west of Neuchatel, I found excellent exhibits of the morainic bowlder clay. If an excavation seen on the east side of this valley were placed side by side with any one of a large number that can be found in Wisconsin, no one but a skilled lithologist or paleontologist could determine to which locality they severally belonged, so striking is the physical similarity of the two formations. Indeed the resemblance of

the rock forming the detrital material is so close that, were the Swiss hill transplanted to certain localities in Eastern Wisconsin, probably no geologist would ever detect the imposition, unless fossils, of which I saw none, were found in it.

16. In company with our genial vice consul at Geneva, Dr. Delavan, I had the pleasure of visiting the celebrated Jardin, in the Chamouni region. A four hours walk up the *Mer de Glace* and over the *Glacier de Talèfre* brought us to an island of sub-triangular outline, completely encompassed by a sheet of snow and ice; and around which clustered an amphitheater of mountain pinnacles. It derives its name, "The Garden," from the fact that, although more than nine thousand feet above the sea, and surrounded on all sides by perpetual snow and ice, a handsome flora of grasses and bright, beautiful, little flowers bloom on its southward sloping side. But, putting aside this interesting phenomenon, and restraining the sentiments, which the magnificent surroundings and the grand views of Mount Blanc and the glaciers below inspire, I can only, in this connection, remark upon the point of chief geological interest to us, viz.: the likeness to our driftless area which this glacier-girt island presents. Let me say, however, at the outset, that the Jardin is not a driftless area. It was formerly covered by an ice sheet and contains erratics on its surface. But at present, though the glacier originates much higher up the slope, it divides and passes around the Jardin and again unites below it, leaving it, so far as present action is concerned, a non-glaciated area, surrounded on all sides by active glaciation.

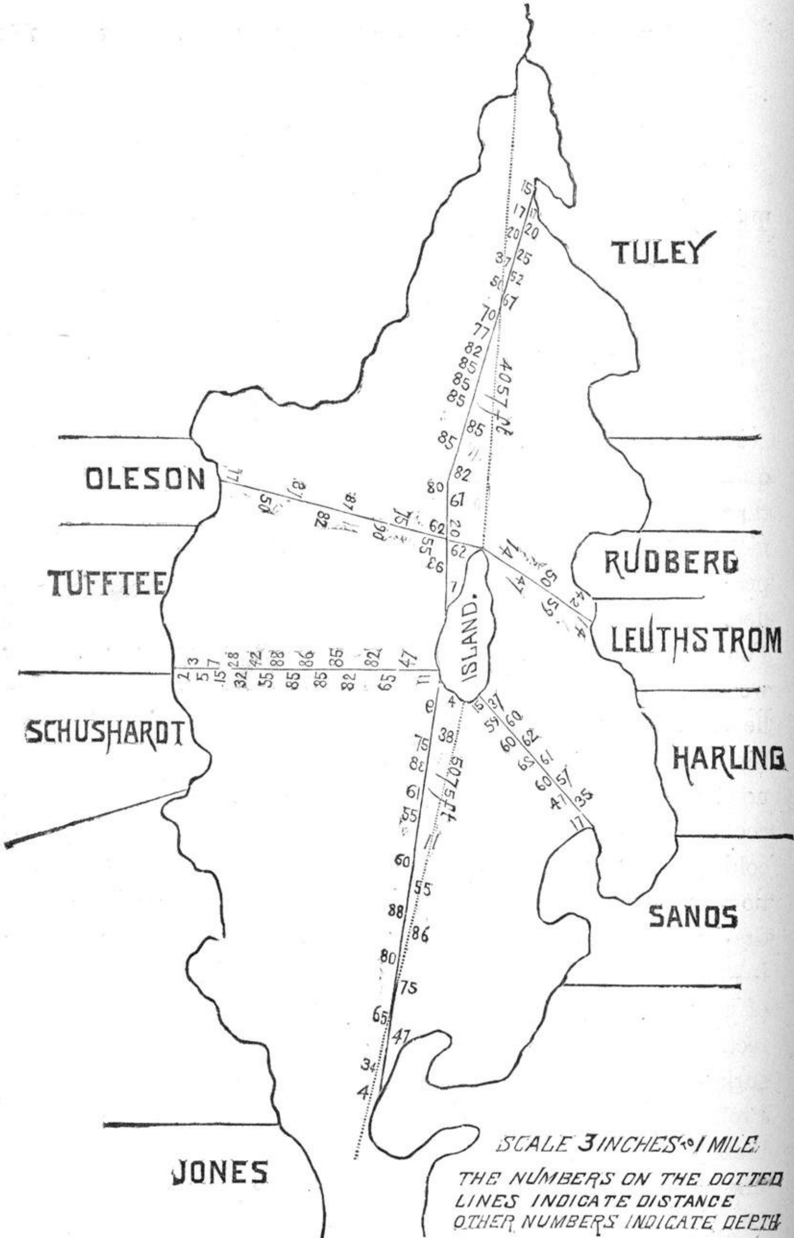
Its likeness to our driftless area, however, ceases here. It is walled in, as is appropriate to a garden, by a steep sharp moraine, thrust up by the ice in moving around it. On the border of our driftless area, the glacial debris thins out very gradually and disappears in an obscure margin. The Jardin differs also, in that it appears to owe its immunity from present glacial action more to its own prominence than to the effects of adjacent depressions. The driftless area of Wisconsin does not lie, like it, on the summit of a protuberance, but on its lee side. The ice of the glacial period surmounted the Archæan heights, south of Lake Superior, in Wisconsin and Michigan, and descended the southern slope a distance of about one hundred miles, where it terminated on the declivity, and its waters continued on across the driftless area, leaving gravel terraces along their course. We must, therefore, seek elsewhere for an adequate illustration of the essential principles involved.

At the foot of the Viesch glacier, the ice stream divides and the branches pass through valleys on either side of a ridge, though the ice at the point of branching is higher than the ridge. Formerly the branches extended much further, and probably united below the ridge. This would be an approach to an illustration of the phenomena in question, but, unless the ice moved over the ridge, and terminated on its slope, it would fail of an essential element.

The right hand branch of this glacier is antagonized by a prominence, and the greater portion of the ice passes through lower channels on either hand; and these subordinate streams approach each other below, leaving an island, or nearly so, on the slope. Above this island the ice terminates on the declivity. On one side the slope is so steep that the ice breaks away and rolls to the bottom, marring the perfection of the illustration, but not destroying its force. The ice, while not really split in twain, is so far thinned by the combined action of the prominence and the adjacent depressions, as to be unable to maintain itself against the wasting to which it is subjected. If the slope were somewhat less precipitous the illustration would be more complete.

Near the termination of the upper Grindenwald glacier, there has recently been a similar instance of an island in a glacial stream with higher ice on either side and above it. In this case, the slope was so great that a portion of the ice above the island became loosened and rolled down to the ice below. The amount which thus passed over was less than an equivalent of the melting capacity of the area of the island, so that, had not the cohesion of the ice been overcome, it would have been melted on the upper margin of the island.

In all the foregoing instances, the areas have formerly been glaciated, and thus differ from the Wisconsin driftless area. They have force, however, as illustrating, in a miniature and imperfect fashion, the fact that, not only may a glacial stream be parted and an island be formed by a prominence projecting through the ice and wedging it aside, or by valleys leading it around; but also that there may be such a combination of prominence and depression as — while not entirely parting the stream — to so thin the ice passing over the prominence, that it shall be wasted and disappear before it can join the main currents diverted on either side; so that there shall be a non-glaciated area, not on the summit of the prominence, but on its lower slope, and these I conceive to be the essential phenomena and elucidation of the Wisconsin driftless area.



PINE LAKE

WAUKESHA Co.
WIS.

TEMPERATURE OF PINE, BEAVER AND OKANCHEE LAKES, WAUKESHA COUNTY, WISCONSIN, AT DIFFERENT DEPTHS, EXTENDING FROM MAY TO DECEMBER, 1879; ALSO PARTICULARS OF DEPTHS OF PINE LAKE.

By Elizabeth M. Gifford and Geo. W. Peckham.

Pine lake is two miles long, with an average width of three-quarters of one mile. Its mean depth, perhaps, being greater than that of any other lake in the county. The most interesting fact resulting from the observations is the regular decrease of temperature with increase of depth down to eighty-five feet. At this depth, from May to November, the mercury was constant at 42° Fahrenheit. In the observations on the temperature of Oconomowoc lake by the late Dr. Lapham — Transactions, Vol. III, p. 31 — he states, "that an attempt was made to find the temperature at the bottom in deep water, and resulted in showing at some times no differences, and at other times one or two degrees warmer or cooler; though the deep water is popularly believed to be much colder than that at the surface." It is probable that his observations were not made with a self-registering thermometer, and in drawing up a common thermometer from any considerable depth, it would take on the temperature near the surface. As a result of a number of experiments we found this supposition to be correct. Our observations show a difference of 14° Fahrenheit, in surface and bottom temperature, until the middle of October. Prof. Nichols found that the temperature in Forest Pond, Cambridge, Mass., was nearly uniform from top to bottom about the first of November. We found a uniform temperature December 2d. Probably in a larger lake this condition would not be reached before January. For valuable data on the temperature of Massachnsetts waters, see papers by Prof. W. R. Nichols, in the Massachusetts State Board of Health Reports.

Pine Lake, Waukesha County, Wisconsin.

These observations were made with the self-registering thermometer, Fahrenheit scale, manufactured by Hicks, of London; checked in same cases by Green's U. S. Signal Service thermometer.

Date.	Time of Day.		Temperature of air.	Temperature of Water.								
	A. M.	P. M.		Surface.	Ten feet.	Twenty feet.	Thirty feet.	Forty feet.	Fifty feet.	Sixty feet.	Seventy feet.	Eighty feet.
1879.			°	°	°	°	°	°	°	°	°	°
May 11	9	....	68	55	....	....	....	....	....	....	....	41
May 15	....	2	68	55	....	....	....	....	....	....	....	41
May 27	....	3	64	60	....	....	....	....	....	....	....	42
June 2	....	6:30	60	62	....	....	....	....	....	....	....	42
June 7	....	7	60	62	....	....	....	....	....	....	....	42
June 11	....	7	72	67	....	....	....	....	....	....	....	42
July 12	....	7	79	79	....	75	60	49	46	44	43	42
July 14	....	4	77	79	71	65	56	50	49	....	....	....
August 11	....	3	82	76	76	75	68	49	46	45	....	....
August 31	10	7	77	75	....	73	....	50	....	....	....	....
August 31	....	3	79	75	....	....	....	50[1]	....	....	....	....
September 1	11	....	77	74	....	....	....	50[2]	....	....	44	....
September 9	10	....	60	62	....	....	....	....	....	44[3]	44	....
September 16	....	5	59	62	....	....	....	....	....	....	44	[4]41
September 29	....	3	60	58	....	....	....	....	....	....	....	42
October 5	....	5	76	62	....	61	59	55[5]	54	43	....	42
October 12	9	....	69	59	....	....	....	59	49[6]	45	....	....
November 1	....	4	40	49	....	....	....	39	....	....	....	34
November 5	....	4	42	48	....	....	....	....	....	....	....	....
December 2	....	2	40	40	....	....	....	....	....	....	....	39

[1] Average of ten observations.
[2] Average of five observations.
[3] Average of five observations.
[4] Two observations.
[5] Two observations.
[6] Two observations.

BEAVER LAKE, WAUKESHA CO., WISCONSIN.

DATE.	TIME OF DAY.		Temperature of air.	TEMPERATURE OF WATER.									
	A. M.	P. M.		Surface.	Five feet.	Ten feet.	Twenty feet.	Twenty-seven feet.	Thirty feet.	Forty feet.	Forty-five feet.	Fifty feet.	Seventy-five ft.
1879.			°	°	°	°	°	°	°	°	°	°	°
May 19......	......	4:00	75	63	....	....	....	....	....	....	....	....	...
May 24......	......	4:30	78	63	....	....	....	57	50	...	....	....	...
July 13......	......	4:00	77	79	....	....	65	....	50	49	....	....	...

OKANCHEE LAKE, WAUKESHA COUNTY, WISCONSIN.

July 14.....	6:45	......	79	80	80	80	[1]76	....	64	49	....	46	44

[1] Two observations.

A DESCRIPTION OF SOME FOSSIL TRACKS FROM THE POTSDAM SANDSTONE.

By Prof. James E. Todd.[1]

[1] At the winter meeting of the Academy in 1879, a verbal description and discussion of these tracks, illustrated by photographs, was presented by Prof. T. C. Chamberlin, but the pressure of other work preventing the preparation of a description for the press, the matter was placed in the hands of the writer. The names here adopted are those then proposed. The specimens on which the descriptions are based — in all about half a ton of slabs — are in the cabinet of Beloit College, and were procured through the kindness of Mr. Young and at the expense of Mr. Chamberlin.

Several months since, Rev. A. A. Young of New Lisbon, Wis., called the attention of the state geologist to some very interesting fossil tracks, that occur at two quarries located near the Lemonweir river. They are about four miles north of the village of New Lisbon. The geological horizon is the upper portion of the Potsdam. The rock upon which they are impressed is a medium-grained, compact, hard, silicious sandstone, which splits readily into flags, three or four inches in thickness. The conditions of its deposition are indicated by distinct, and often oblique lamination, and by ripple marks. No animal remains have yet been found associated with the tracks, though these are remarkably well preserved.

1. The general appearance of the tracks is of broad serpentine bands crossing the stone, and sometimes so thickly as to obscure one another, and give the appearance of an irregularly rippled surface.

The margins of the tracks appear to have been originally unbroken lines, and parallel. The whole surface between these lines has evidently been in contact with the animal making the track, and there are no signs that any part of the animal reached beyond these lines.

2. The most conspicuous element of the track consists of a closely consecutive series of nearly parallel, transverse ridges,

which, moreover, are not usually straight and exactly transverse, but most frequently V-shaped with the apex of the V pointing forward. This form, though the prevailing one, is nevertheless subject to the following modifications: The angle varies in the

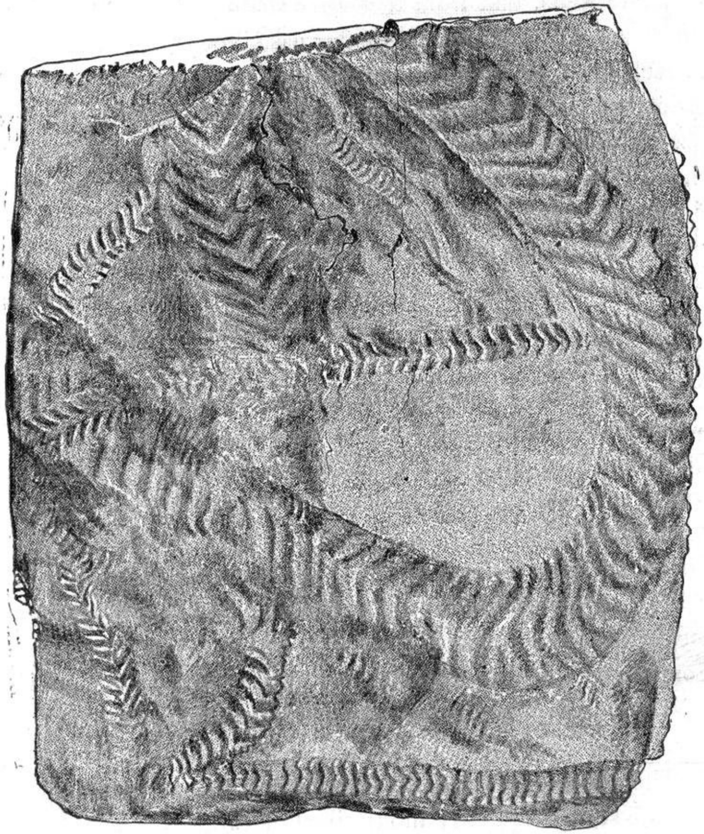


PLATE 1—FOSSIL TRACKS ON POTSDAM SANDSTONE.
(From photograph.)

typical cases from the extreme limit of 110° to 135°. When the V becomes distorted, this angle appears to vary further, through larger angles, till, in various cases, it disappears, and the ridges are straight. This occurs somewhat more commonly in the smaller tracks.

Another frequent variation is in the relative length of the arms of the V, and the consequent shifting of the point towards one side of the track. When the V remains at all regular this is toward the convex margin when the track is curved (*vid.* plate 1).

The surfaces of the ripple-like ridges are usually regularly convex, and this convexity is so nearly equal to the concavity of the furrows between, that from this feature alone, it would be impossible to say whether, in a particular case, you were looking upon the track itself, or upon the cast of it, found on the upper slab. Not infrequently the ridge is narrower than the furrow. Sometimes the converse is true. If either slope of the ridge is more inclined than the other, it is usually the posterior one, unless it has been modified by longitudinal lines, when the converse may be true. With this character may be connected the fact that from the way in which the stone breaks in the ridges, there is additional evidence that the ridges in their formation were pressed and moved backward somewhat.

Not infrequently the arms of the V are not formed together; sometimes they alternate for a time, sometimes an extra arm is intercalated between two V's, which are distorted, to adapt themselves to the case. Such cases occur more frequently in curves, but are not confined to them.

Sometimes the V-form of the ridge changes to a wavy line, a low W, a regular curve, or a straight line, and that within a short space, in the same track.

Sometimes the transverse ridges appear to fade out, as if the consistency was insufficient to sustain them after they were formed.

3. The third element of the tracks are the longitudinal lines. These are seen frequently modifying the tops of the ridges, and forming the most reliable guide, in determining which impressions are the tracks, and which the casts; also, in which direction the animal moved. The track may also be sometimes distinguished from its cast, by its transverse section being a little concave or depressed.

These markings may be divided into three kinds.

First, those quite closely parallel with the sides of the track, as though formed by some appendages dragged over the ridges after they were formed. Of these, some seem to be made by rigid, posterior points, or by the lateral edges on some kind of a caudal shield. This appears in pl. 1, toward the left above, and in unfigured examples. The most common ones appear as if formed by flexible bristles dragged over the track. They are sometimes wavy, as though the appendages swayed from side to side.

The third kind of markings is best seen near the sides of the curves, and then only in rare instances. These cross the transverse ridges more nearly at right angles and appear to have been formed by bristles of some kind attached to whatever formed the ridges.

As to the dimensions of the tracks, it may be said that they vary greatly, though all may be grouped in three sizes. The largest are 4–4½ inches wide, with a distance of 1⅛–1¼ inches between the transverse ridges, when of the normal form. When there is a curve, the ridges may be much closer towards the inner side of the curve and more distant on the outer side. This size includes the most conspicuous tracks on pl. 1, where one presents a curved course over five feet in length; also upon pl. 2 and pl. 3, 1 below, and 2. The three kinds of finer markings are found only in tracks of this size. The next size is 2–2½ inches across, about ½ inch between the ridges, and the smallest size is from 1¼ to 1¾ inches in width. All of both these sizes show the cross ridges with the V more or less clearly marked, intercalations, and the usual convex surfaces, with perhaps one exception, which is seen at the bottom of pl. 1. In this one the ridges are flattened with a slight dip forward. This may be formed by a distinct species; while the others may be conceived as formed by different stages of the same species.

These tracks closely resemble some described by Sir W. E. Logan, from Perth, Canada, and named by him, *Climactichnites Wilsoni* (*vid.* Geological Survey of Canada, 1863, p. 107). A figure presenting more of the details, is found in Dana's Manual, p. 176. They have been ascribed by different geologists to Molluscs, Worms, and Trilobites. These under consideration differ from the Canada tracks, however, in lacking the marginal ridges in all cases, except one very equivocal one. So far as we are aware, they are also without the finer longitudinal markings.

It is possible, however, that the difference is owing mainly, if not entirely, to a difference of the medium in which they were found. These Wisconsin tracks, as before implied, were formed in loose sand, composed of rounded grains. Similar animals, moving upon mud, would probably push up, on either side of the track, a ridge of sufficient consistency to stand. We are not informed as to the character of the rock in which the Canada tracks are found.

For convenience for future reference, the larger tracks described, showing occasional longitudinal and wavy markings, we would provisionally name *Climactichnites Youngi;* and under this would include all the smaller ones, showing regular convex and V-shaped transverse ridges. They may prove to have been formed by immature individuals. The solitary track, pl. 1, below, with flat and usually straight ridges, may be a variety of the same; but these differences, with others not easily expressed, seem sufficient reason for designating it by another name, viz.— *Climactichnites Fosteri.* It should be distinctly understood that the names may be discontinued, whenever the name of the species of animals which formed them can be definitely and satisfactorily substituted.

This paper would doubtless be considered incomplete, did it not give at least some conjecture concerning the character of the animals which formed these tracks. (We say animals, for the suggestion of Prof. Chapman, of Toronto, that *Climactichnites* are impressions of Fucoids (*vid.* American Journal of Science, vol. 14, p. 240), clearly cannot apply to these under consideration. The longitudinal lines and variations of the transverse ridges, appearing with such irregularity, forbid the idea.)

Endeavoring to confine ourselves strictly to the facts, and the most patent inferences therefrom, we conclude that, whatever the nature of the animals and whatever the form of their anterior ambulatory organs, those leaving the last impressions were very perfectly flexible. This is shown in the very variable form of the transverse ridges, as noted above.

They must have been in pairs, and each capable of motion, independent of its fellow. This is proved by the intercalated ridges.

Each separate organ seems usually to have been moved backward, and inward, in that way forming the V-shaped ridges.

The deepness and smoothness of the impressions may be partly the result of similar movements of successive organs, pressing into the same furrow. The longitudinal lines may have been easily made, it would seem, by a rigid candal shield, furnished, in some cases, with bristles, or slender spines.

The finer traces, nearly transverse to the ridges, may have been produced either by the "recover of the paddles, or by the flowing of the mud," caused by their motion, or the onward movement of the animal. The latter supposition is strengthened, by their appearing only in places, where, from the lowness of the transverse ridges, and apparent washing of material into the depressions, the sand appears to have been of very slight consistency. On this supposition, the long curved track in pl. 1 passes at its sharpest turn, over a firmer spot, but elsewhere the bottom seems to have been much softer. So also in plate 3, 1 below, the track seems have been formed across a series of low ripple-ridges. After all, we must frankly admit, that of thelength, the weight, and the morphological structure of those ancient animals, we learn nothing decisive; and that with a scientific use of the imagination we get little more than a glimpse of the posterior part of their ventral surface.

A CHAPTER ON FOUNDATIONS.

By J. Nader, Civ. Eng., Madison, Wis.

The subject of this paper is perhaps one of the most difficult and uncertain problems which comes within the province of the Civil Engineer.

In treating on the subject of foundations, I will endeavor to review the whole practical series, from the ordinary foundation daily required and constructed, to such as tax the ingenuity of man and call forth the efforts of the highest quality of genius and talent.

The earth's surface, consists of all grades of solidity from the rock, to inpalpable mud; for this reason we have to be governed by circumstances, and where nature fails us we must supply the want by artifice.

1st. Beginning with the most stable, the rock, it is only necessary to prepare the surface so that it may receive the intended structure and all requirements are satisfied. Cases may, however occur where the rock bed is of such nature that it will disintegrate by the action of the elements, in all such it is simply necessary to excavate beyond the influence and replace the excavation with enduring material. Where the rock is of sufficient strength, the superstructure may receive considerable strength against lateral motion, as in the case of Eddystone and Bell rock lights, England, also Minot's ledge light and others in this country, by bolting the structure securely to the bed rock.

2d. Next to solid rock is a bed of hard gravel; this will in nearly all cases resist any amount of pressure that can be brought to bear, provided that in cold climates, the substantial work is carried to a depth beyond the influence of the frost.

3d. I shall presume to place sand next in order, to gravel, for solidity. In sand, it is only necessary to go beyond the frost line and to guard against lateral motion; in every other respect it will support weight equal to rock itself.

4th. Next to sand, impervious clay may be in order of resistance to pressure. This is a very common earth which yields only to the pick, is not plastic and does not become so from effects of moisture. A solid rock is scarcely more reliable against pressure than this clay.

5th. We now come to the less resisting soils among which the first are the plastic clays. These earths give good resistance when dry but undergo a soaking process from the effects of moisture and becoming plastic they yield to a considerable degree and many fine buildings have unaccountably failed a few years after their erection, while the fact was, that their very presence conducted the moisture to the bed of their foundations and became the means of their own destruction.

6th. And last brings us to the treacherous yielding alluvial beds among which the engineer is obliged to flounder with uncertainty in seeking a solution of the problem of stability.

Having touched upon the various earths and soils which come into practice, the problem is, how to construct with safety and economy under varying circumstances.

As before remarked, with a rock bed it is only necessary to prepare the bed to receive the desired structure.

With the second class, i. e., gravel bed, it is necessary to extend the base beyond the thickness of the wall to guard against lateral motion; as a rule an increase of about one-half the thickness of the wall will give a sufficient base. In some ordinary foundations in gravel, trenches are dug to the desired depth and filled with irregular fragments of stone and then grouted with thin mortar of lime or cement, in many cases the dry stone foundation alone is relied upon. The foundation of Fort Hamilton, New York Harbor, a granite battery of two tier of guns, is built of dry stone. The Fort has stood about fifty years with no sign of failure. The ground is gravel and hard clay. In case of bridge piers or abutments it is of course necessary to protect the bed from erosion by the force of ice gorges or freshets. This portion of the subject will be treated further on.

In the case of sand for foundations, I have presumed to place the same next in order to gravel. As before stated, sand is equal to rock if lateral motion is prevented. There is, however, one precaution necessary, and this is, that the thickness of the bed of sand and the substratum should be examined and very carefully, as many cases have occurred in which the superstrata of sand was not of sufficient thickness to give reliable resistance. In such cases, as in the fifth class, resort to artificial support must be had as will be noticed as I progress.

In the 4th class there is no particular precaution necessary as it is presupposed, as already stated, that the bed will give sufficient resistance.

In considering the sixth class we arrive at that portion of our work where we may expect to meet the unusual difficulties, where science is often at fault, and where extensive practical knowledge is necessary to overcome the difficulty. It would perhaps be a loss of time for me to go over the ordinary methods of constructing foundations in what are considered substantial beds, excepting where I may have occasion to touch upon foundations for particular structures, my purpose is to review the best methods of overcoming the greatest difficulties.

General Delafield, ex-Chief of the U. S. Engineer Corps, has written a work upon foundations in yielding soil, in which he gives conclusive proofs of failure, in every case, of grillage or platform foundations. These foundations are made by excavating to a sufficient depth and placing two or more courses of strong timbers at right angles over the ground to be occupied; the spaces between the timber are then filled with bèton composed of cement, sand and broken stone or gravel. Over this is placed one or more courses of strong plank placed in close position and securely fastened to the grillage, and the structure is erected upon the floor thus resulting.

As before stated, these foundations have failed in every instance where extensive permanent buildings have been erected upon the same, and it was the opinion of General Delafield that the same should not be used unless in connection with some more reliable supports.

The platform foundation being a failure, our next resort is piling, and the different manners in which this may be applied, is one of the particular points I wish to touch upon in this paper.

Major Sanders of the Engineer Corps and Mr. McAlpin, Civ. Engr., have had perhaps the best opportunities of investigating this class of foundations and supplying reliable practical formulæ. Major Sanders has experimented and successfully constructed at Fort Delaware and Reedy Island on the Delaware river, on the most treacherous alluvium, upon which a permanent extensive building has perhaps ever been erected. Borings were made at these places to a depth of about 50 feet and nothing but a liquid impalpable sea of mud was found. Piles were driven from forty to ninety feet deep with the greatest ease. Trial piles were driven and loaded with great weights and the effect of these weights was observed and recorded during a series of years; from these observations a formula was deduced which became a basis of the construction of the foundation of Fort Delaware and similar structures.

Mr. McAlpin, eminent in his profession, had charge of the construction of the United States dry dock in the Brooklyn navy yard, and had to contend with a treacherous bed of quick sand and springs, where the difficulties encountered are almost indescribable and the engineers were at times almost driven to despair.

The results of the labors of the aforementioned engineers were almost identical and the application of their formulae, will, in doubtful cases, be liable to err on the side of safety.

At Fort Delaware, the possibility of reaching a bottom support for piling was out of the question, on account of the expense. The alternative was to consolidate and compact the super strata in such a manner as to support the weight of the design by driving as many piles as the ground would admit of; the piling was substantially capped, the spaces filled with bèton and covered with a strong timber floor, upon which the Fort now stands, without any failure. Had there been a hard substratum at a reasonable depth, the piles would in that case be only so many columns supporting the superstructure.

Major Sanders' formula is as follows :

Divide the fall of the ram in inches by the motion of the pile at the last blow in inches; multiply the quotient by one-eighth of the weight of the ram in pounds, the product will be the weight the pile can bear with safety.

$$\left(W=\frac{R\times(h\div z)}{8}\right)$$

Mithel's screw piles have been used with good success; they consist of iron piles in sections of desirable length, the bottom section having one turn of a broad iron screw; these are forced into the ground by turning them around by means of levers moved by man or horse power. The government of Great Britain has built a number of bridges in India upon screw pile piers, which have all been successful.

The screw cylinder I consider a great improvement over the screw pile. The cylinder is made of cast iron of convenient lengths; the lower section is provided with a screw on the outside, of a foot or more in width, the sections are screwed and bolted together by flanges on the inside; the earth is removed from the inside by suitable implements as fast as the cylinder progresses. The cylinder is afterwards filled with concrete.

The Triger system of foundations (so named from its inventor) and largely improved and applied by Mr. Hughes in England, is in reality an enlared hollow pile, and ultimately led to the use of very large cylinders and caissons. I present herewith a plan of an iron centre-pier for a swing bridge, the process of the operation of lowering, excavating, under pinning and filling is shown in the drawings. The centre pier of the iron swing bridge over the Harlem river at New York was constructed in this manner by Mr. McAlpin. There was one central and nine circumscribing cylinders of six feet diameter, these were put down from 60 to 80 feet until the bottom was considered sufficiently resisting to bear the great weight. When the cylinders came to rest, the base was enlarged four feet in all directions, this increased the resisting area to forty-nine as against nine without this precaution.

If there is much trouble from leakwater, the Plenum and Vacuum process may be applied by putting an airlock on the top of the cylinder and forcing in air under sufficient pressure to expel the water. When the excavation has proceeded as far as possible, the process is reversed and the air exhausted, the atmospheric pressure will then force the cylinder onward.

At the building of Skilligalee Light House, a great deal of difficulty was encountered. The shoal upon which the light is situated is in the northern end of Lake Michigan some miles from the east shore and is composed of gravel and boulders. As it was impossible to drive piles and the mass so irregular in consistence other means had to be employed in order to get a safe foundation.

The area was first enclosed by a secure cribdam, inside of this an iron cylinder sufficiently large to enclose the foundation of the tower was placed, open at top and bottom. It was supposed at first that the water could be kept down by means of pumps and the excavation be made it the open cylinder. It soon appeared that this was impossible; sheet piling was out of the question, and no matter how tight the cribdam might be made, the leaks through the boulders and gravel from below would still remain.

A diaphragm was constructed in the cylinder and the excavation continued under the plenum process until the cylinder reached about 13 feet below the lake water level.

Stone and other materials were passed through an air lock to the workmen below, and the lower part of the cylinder was built up with solid masonry until there was sufficient weight to exclude the water; the diaphragm was then cut away and the work continued from above. The unavoidable manner of operating brought the work into what we know at present "caisson," an exceedingly expensive and tedious plan, and, as in the case above mentioned, should only be a last resort when no other plan will promise success.

The latest wonders in construction are now before us. One the great steel arch bridge so successfully completed across the Mississippi at St. Louis, and the other now in process of construction across the East river at New York. In the case of the St. Louis bridge, the certainty of reaching bed rock was a great inducement to the engineer to adopt the caisson and place his work thereon, although a stratum of good earth was found under the river drift, which continued the same to the bottom. Had it been impossible to reach rock, a coffer-dam enclosure would have enabled the excavation to be made and bearing piles to be driven and would, in my estimation, have made a foundation as safe as the present one.

The Brooklyn caisson of the East river bridge rests for the most part on a bed of boulders and hard-pan at a depth of 44½ feet below mean high tide and the top of the caisson at 20 feet.

The depth of water is from 12 to 16 feet in front of the tower; the river drift was perhaps 12 to 14 feet deep. This leaves us but 30 feet from mean high tide to a good foundation, if properly treated.

This Brooklyn caisson cost something over $300,000; a coffer-dam would have cost less than $100,000; the excavation would have cost less also than the masonry; so that it is very evident that there would have been a considerable saving in cost. The weight resting upon the bottom is about 5½ tons per square foot, and is considered entirely safe. The settling at the water line has upon close observation barely exceeded one inch at any point.

The consideration of these two extraordinary structures has brought us to the subject of foundations in water. Many of the plans mentioned in a preceding part of this paper are applicable to piers and abutments in water. The solid and hollow screw pile and iron cylinder can be applied with success. A very common plan for piers consists of a sufficient number of bearing piles surrounded by timber cribs and the space filled with loose stone to support the piles against lateral motion. The crib is not permitted to rest upon the bottom but is supported some distance above so that the stone may roll out and assume a position which will give a broad base to the filling.

A very excellent plan for building piers and permanent wharves has been extensively applied by the U. S. Eng. Corps, where the bottom was of substantial material: A scaffold is erected upon piles driven by a floating pile driver, upon this the exact location of each pier is determined. Loose stone or bowlders are removed from the site and a sufficient number of bearing piles are driven and sawed off perfectly level close to the bottom. See plan of saw. The bottom course of the pier of 4, 6 or 8 feet square and 2 feet or over in thickness is composed of one stone, this stone is lewised at the corners and supported by chains to which are attached large screws which pass through timbers on the staging. The first stone being placed in the slings it is lowered to the level of the staging. The second course composed of two or more stone is then built upon the first and set in mortar and clamped and doweled together. The screws are then slacked down until the top of the course is level with the staging, and so continue until the work reaches bottom. The several piers are then connected by iron beams and brick arches covered with concrete, the surface may be paved with any suitable material. I can state from my own experience that such piers have been built in from 12 to 20 feet of water without the least difficulty.

Gen'l Richard Delafield's memoir on foundations in compressible soils is probably the ablest investigation on the subject.

PRIMITIVE ARCHITECTURE IN AMERICA.

The Different Stages and Modes of Life Exhibited in the Pre-historic Works of America.

BY REV. S. D. PEET, EDITOR AMERICAN ANTIQUARIAN.

One of the most noticeable things in the prehistoric works of America is that they present native architecture in various stages of development. The study of these works furnishes a clue to the states of society in pre-historic times. It also affords us many hints as to the pre-historic races, and their origin, growth and development. There is need, however, that we have a better understanding of these stages themselves. Now we propose to study the pre-historic works of America, so that, if possible, we can trace the line of development of society, or if not, so that we can discover various grades which have been presented by it. One of the difficulties in tracing a connected development is that these works are so separated from one another by geographical lines, that we cannot ascribe them to the same people. This is favorable in one respect, because the lines which separate the grades are distinct, and we can thus determine the characteristics which belong to each. There are all the differences between the pre-historic works found on this continent that have been supposed to exist in the works which have been so faithfully studied in the European countries. But the differences here are marked by peculiarities of architecture, rather than those of art; the cultus here being exhibited by the works, rather than by the relics.

There are no names which define or describe the stages of society here, such as are used in Europe, but those stages, nevertheless, exist, being shown here by primitive architecture, as they are there by primitive art. The ages which have been so clearly distinguished, and which depend upon the material of the relics found in Europe, have not been identified here, but the grades of society are shown by the material used in architectural structures, and so the lines of distinction are somewhat similar. The geographical lines separate the works, and the material distinguishes them. In Europe the different relics are found in the same locality, and successive stages of cultus have been discovered, being identified by the material used, as well as by other characteristics. It is supposed that successive waves of population have thus left their tokens; possibly different races have overrun the same locality. But the growth of society has been much more connected in Europe than in America. Here wide districts have separated the races and their works, and the ruins which are discovered in these districts are so unlike, that they indicate different lines of development, if not different ethnic origin. Wherever a succession of races has been discovered, we have found that some of the races had prevailed elsewhere, and intruded themselves upon the domain of others. The study of the works, peculiar to each geographical locality, has revealed this fact, for it is easy to trace the resemblances and so identify the works with the races. If there are earth-works found in Mexico and Central America, they are not the characteristics or predominant structures. If there are stone cysts and occasional stone-walls in the Mississippi Valley, still the earth works are the prevailing structures here. This identifying the architectural peculiarities of one locality, in the midst of the works belonging to another, has this advantage; it enables us to see the grades which architecture has reached and associate them with the different states of society. The only disadvantage is, that it prevents us from tracing any connected development; in other words, instead of blending together, as they do in Europe, the works are here separated in wide gaps; great difference in architectural forms being discovered. It is not difficult to trace the grades, but it is difficult to discover the connecting links.

We propose to examine the works which are peculiar to the different geographical localities and to compare them with one another, and so endeavor to ascertain if there was any separate line of development. The first class of works which we shall examine will be those which are known to have been erected by the Indian tribes and which prevailed, extensively, both on the Atlantic and the Pacific coast. The second will be those found in the Mississippi valley which are generally known by the name of the Mound Builders works. The third, those found in the Great Plateau of the West, known as the Puebloes. The fourth class are those which belonged to the civilized races of Mexico and Central America. We might, indeed, also examine the works of the different geographical localities, and compare them, and so endeavor to ascertain whether there was any connection between them; that is to say, whether there was any development of one into the other. If the development is continental instead of local, it should be recognized. The transition from one to the other is so abrupt, that it is difficult to trace any connection. The architectural forms follow different types, and the whole character of the pre-historic works, in the separate localities, show a development so distinct that we can hardly find anything in common.

I. We shall consider first, then, the House Architecture, and, afterward, the Military Works, which are known to belong to the various Indian tribes.

In considering the works of this class, however, we shall examine them in all localities, wherever the Indian tribes are known to have prevailed, and so compare them with the works of each locality.

We shall not, then, in this paper, undertake to trace any common type through the different geographical localities, but shall refer to those which are characteristic of the separate localities, and shall, by this means, undertake to show what different grades of architecture have appeared in the different portions of this continent.

We may see, also, that these different grades are associated with the different states of society; the first, with the hunter life; the second, with the agricultural; the third, with the village life; the fourth, with the civilized state.

In taking this position, we do not deny but that these different states of society and the corresponding architecture prevailed to a certain extent outside of the particular localities to which they

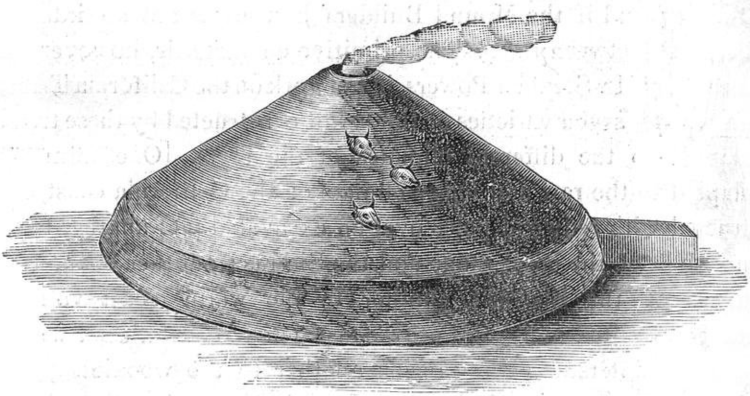
KUTCHIN LODGE.

TULARE LODGE.

are ascribed. But they most abound and are best known in the localities to which they are referred.

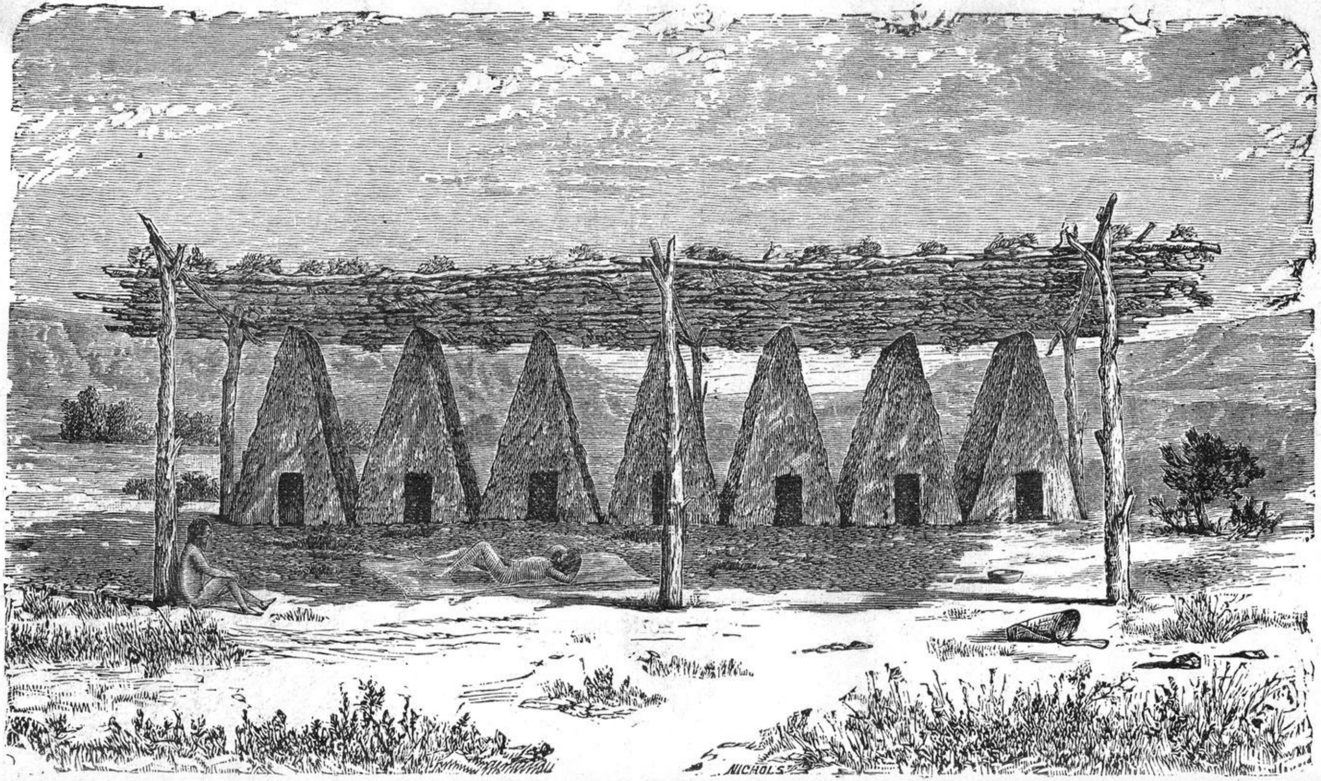
We maintain that, whatever races built the separate works, the grades of architecture are so unlike as to show an entirely different social status. The mode of life and the social status corresponded, and the architectural grades partook of each.

We proceed, then, to consider the house architecture of the uncivilized races. We do not need to refer to the Indian Wigwam, to show that this style of building was very primitive. There were many different methods of building houses among the Indians. It is difficult to say whether, under certain circumstances, they did not build even in the same style with the Cliff Dwellers, and if the Mound Builders' house was not an intermediate link between them. The primitive character is, however, noticeable. "Mr. Stephen Powers, in his work on the California Tribes, enumerates seven varieties of the lodge, constructed by these tribes, adapted to the different climates of the state. [One form was adapted to the raw and foggy climate of the California coast, constructed with redwood poles over an excavated pit] another to the snow-belt of the coast range and the Sierras; another to the high ranges of the Sierras; another to the warm coast valleys; another, limited to a small area, constructed of interlaced willow poles, the interstices being open; another to the woodless plains of the Sacramento and the San Joaquin, dome-shaped and covered with earth; and another to the hot and nearly rainless region of the Kern and Tulare valleys, made of tule. * * * [The round, domed-shaped, earth-covered lodge, is considered the characteristic one of California; and probably two-thirds of its immense, aboriginal population lived in dwellings of this description. The doorway is sometimes directly on top, sometimes on the ground, at one side."] We give a cut of this form of lodge, and would call attention to the resemblance between it and the Maudan lodge. The Mandans occupied the country on the Missouri river, and their lodges have been described by Catlin in his North American Indians. The remains of similar lodges are found in quite considerable numbers in southwestern Iowa, many small circles of earth having been discovered on the bluffs bordering the Missouri river, showing where the lodges had been located and were fallen down. The Kutchin Lodge is somewhat similar in form, but is generally covered with deer-skins dressed with the hair on. The Ojibwa cabin, which may still be found on the south shore of Lake Superior, was also similar; though it came to a point at the top, forming a perfect cone, and was covered with birch-bark. The Dakota lodge was constructed with a frame of poles; the poles, 13 in number, being from 15 to 18 feet in length, were tied together at the top, and a number of tanned buffalo skins were stitched together and drawn

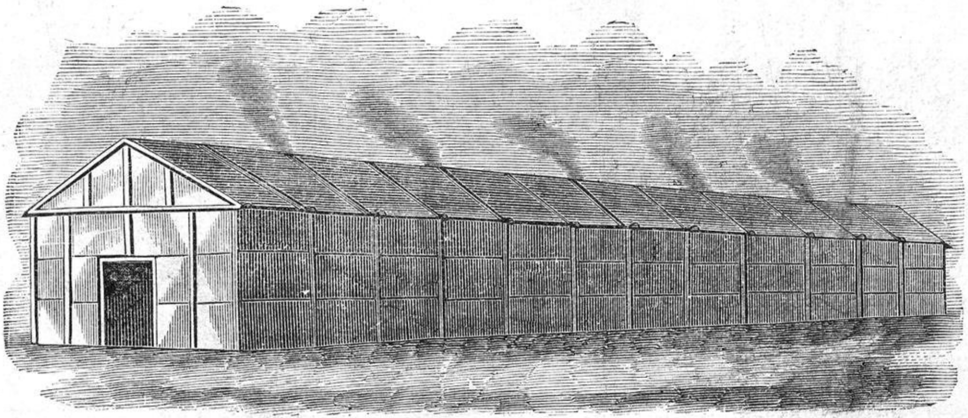


MANDAN HOUSE.

over these. The Winnebagoes, formerly in Wisconsin, built their lodges in the same way, but used rough mats for covering. This hemispherical or conical shaped house is probably the most common of any among the rude uncivilized tribes in all countries. Lodges, resembling them, are described as common in Africa. The Zulus to-day live in houses which might be mistaken for Indian wigwams, and even their palisades, which surround the inclosures where these lodges are situated, might also be mistaken for Indian stockades. A second form of lodge, found in California, is the one given in the cut which is taken from Mr. Powers' work. This wigwam is in the shape of the capital letter L, made up of slats, leaning up to a ridgepole and heavily thatched. There are three narrow holes, for entrance, one on either end and one at the elbow. Half a dozen such houses make an Indian



THATCHED LODGE.



LONG HOUSE.

village, with the addition of a dome-shaped assembly or dance house in the middle, or open space. One or more acorn granaries, of wicker-work, stand around each lodge, much like hogsheads in shape and size, either on the ground or mounted on posts as high as one's head, filled with acorns and capped with thatch. Similar to this style is the Yokuts lodge, also described by Mr. Powers. Every village consists of a single row of wigwams, conical or wedge shaped, generally made of tule, and just enough hollowed out within so that the inmates may sleep with the head higher than their feet, all in perfect alignment, and with a continuous awning of brushwood stretching along in front. In one end wigwam lives the village captain; on the other the shaman or *si-sê-ro.* In the mountains there is some approach to this martial array, but it is universal on the plains. Perhaps the most completely developed house was that found among the Iroquois. This has been described by L. H. Morgan, in his work on House-Life and House Architecture. It consisted of a strong frame of upright poles set in the ground, which were strengthened with horizontal poles, attached with withes and surmounted by a triangular, and in some cases with a round roof. It was covered over both sides and roof with large strips of elm-bark, tied to the frame with strings or splints. A similar frame work was then placed outside of the bark both along the sides and on the roof, and the two frames tied together, with the bark between. At each end was a doorway, covered with suspended skins. Within, the house was divided into compartments like stalls, a passage way running through the whole house from end to end. These long houses of the Iroquois were often 50, 80 or 100 feet long, and sometimes occupied by 20 families. (See cut on opp. page.) The Algonquin houses were built in a somewhat similar manner, a large, rounded house, from 50 to 80 feet in length, covered with matting in the place of bark, and large enough to accommodate several families.

The Iroquois and Algonquin tribes generally dwelt in villages. The village consisted of a number of tenement houses, arranged around a central open space, and surrounded with a palisade. Some of them were not enclosed with a palisade. These houses have been described by Sir Richard Grenville, who visited Roanoke Island in 1655. An artist, John Wyth, who was with the expedition, has furnished a number of valuable sketches of these villages. The description of Pomeiock is as follows: "The towns in Virginia are very like those in Florida, not, however, so well and firmly built, and are enclosed by a circular palisade with a narrow entrance. In the town of Pomeiock, the buildings are mostly those of the chiefs and men of rank. On one side is the Temple (council house), (A) of a circular shape, apart from the rest, and covered with mats on every side, without windows, and receiving no light except through the entrance. The residence of their chief (B) is constructed of poles fixed in the ground, bound together and covered with mats, which are thrown off at pleasure, to admit as much light and air as they may require."

We have thus given, at considerable length, a description of the house-architecture of the different Indian tribes. We may discover in all these houses a very great similarity, and can easily perceive that a great difference exists between them and both the Pueblo houses of Arizona and the cliff-houses of Colorado and New Mexico.

We turn now to consider the stockades and military architecture of the uncivilized races. This architecture is well known, for history has made a record of them. What history lacks, also, archæology furnishes, for there are many remains of the forts and stockade-villages of the later Indians. These remains are found, oftentimes, amid the works of the Mound-Builders, but they can be easily distinguished by their peculiarities. They consist of a simple, rude wall in the form of a circle, with a ditch on either side, but with no signs of any pains taken, either with their form or finish. They are generally found situated on the summit of some hill, near some stream or spring, and in places capable of defense as well as suitable for residence. They can be distinguished from the Mound-Builders' works, for these are much more massive, have a higher architectural finish, and were used for many other purposes than as defenses. There are many remains of stockades throughout Northern Ohio and in Michigan, where it is known that the Red Indians had their habitation, and where the country itself was favorable to the hunting life. There are also a few such works found along the Ohio river and in the southern states, but they seem to have been intruded among other works and probably were later in their origin and more transitory in being occupied. The habitats of the stockade-builder, however, seem to have been New York State, and the regions east of the Alleghany mountains. Vast numbers of their defenses and villages are now discovered upon the hill-tops of this region. S. G. Squier has described no less than three hundred of them in the State of New York alone. The works of the Mound-Builders are distinguished from these not only by being in a different geographic locality, but by belonging to a different grade of architecture. If the Mound-Builders were Indians, they were Indians in a higher stage of culture, for their works show much more skill and a different state of society. The warlike Indians would naturally erect stockades and then make their predatory excursions and pursue their warlike life, in such regions as would furnish the best defenses. No place was more favorable to this than that very state where the Six Nations, the Iroquois, made their home. Surrounded on all sides by mountain barriers or great bodies of water, they were safe in their retreat, yet they were so closely connected with other parts of the interior, both by the lines of the Ohio river and its branches, by the great chain of lakes, and by the Ottawa river in Canada, that it was with great ease that they could attack the inhabitants to the west of them. They overran the whole interior, and subdued the wild tribes existing there.

We have only to imagine a similar history connected with other races at a previous date. The evidences of history are that the tribes situated throughout this valley of the Ohio river, and the upper Mississippi were, when first known to the white man, in the same warlike state. The Eries, Wyandots and Shawnees, the Miamis and Illinois, the Cherokees, and, perhaps, the Choctaws, were all in a migratory condition where it was impossible for them to have attained any settled state, or to the agricultural condition. They were hunters, and seemed to have been so for very many years. It is probable that the remains of stockades in the midst of the earthworks of this region, are the ruins of their habitations. By comparing these with others, which have been described by history, we shall be able to see that they represent a very different stage of development from the earthworks with which they are associated. We do not deny that some of the Indian tribes reached a high stage of development and attained to considerable architectural skill, but there seemed to be a great difference between their works, at their best, and the works of the Mound Builders, both in style and finish, and other peculiarities.

The Mound Builders may possibly have used stockades, and made their earth walls serve the purposes of parapets, and so their works would be only a development of this. Yet, even then we must ascribe different grades of architecture to the two classes of works. The material used is certainly different, and the style is different. The Iroquois built perpendicular structures, without any platforms, and depended upon the strength of timber for defense. The Mound Builders built their structures in the pyramidal style, and depended upon the strength of their earth-walls both for defenses and observatories.

The Cliff Dwellers and the Puebloes had a still different mode of defense. They erected perpendicular walls, but built in terraces, and depended upon adobé or stone as the material which should resist attack. Where they did not build in terraces, they put their houses into the niches of the rocks, and depended upon the Cliffs for protection.

That the ordinary Indian had a different grade of architecture from the Mound Builders or the Puebloes, is evident, also, from other circumstances.

II. We now turn to the works of the Mound Builders. I think we shall find among them, an entirely different grade of architecture and a different mode of life. We are not now considering the question whether the Mound Builders were Red Indians, or not, but whether their mode of life, their social status and their architectural skill were not all different from those with which we are familiar, as belonging to the Indian tribes. One of the first things which impresses us in this connection is the difference in the locality in which the Mound Builders made their homes. The later Indians sought the forests and made their homes beside the rivers and lakes, but the Mound Builders either sought the prairies or the rich valleys, and erected their largest structures where the land was most fertile, and where the resources of agriculture were most productive. The conclusion is forced upon us that they were agriculturists. While there are many works which show that they depended upon hunting, and that they also were warlike and erected many works of defense, yet that the peaceful, agricultural life was the prevailing one, is evident. They certainly evidently selected the sites for their homes, more with a view to the agricultural advantages, than to the military. There are many military works which evidently belong to them, but their most complicated and elaborate structures are found in the most fertile regions, in localities favorable to an agricultural life, and yet so secure as to render their permanent settlement possible. The grades of architecture among the Mound Builders' works correspond to this idea, a wonderful correlation existing between them and the topography. The great capital of the Mound Builders of Ohio, for instance, was at Newark. Here it is plain that agricultural life was pursued. The great Circle at Circleville is also in the midst of a rich valley. The works at Chillicothe, at Marrietta, at Portsmouth, were all situated in rich agricultural regions; even Ft. Ancient, on the Miami, was on the borders of a high but fertile prairie, while the valley of the Miami below furnishes other facilities for culture, as well as resources in its waters. The Great Mound at Cahokia is situated in a fertile region, known as the Great American Bottoms, and shows, both in its vast dimensions and the number of surrounding works, that it was in the center of a thickly populated locality. The great mounds at Etowah and Eufaula, Georgia, are also in that fertile region which has been described by the early historians as occupied by a peaceful, agricultural people. Descriptions are given by the historians connected with Ferdinand De Soto, of great corn-fields, of numerous villages, of powerful tribes located on the rivers, of chiefs or *caciques* having their houses on the summits of platforms, and of an industrious and thrifty people. They were certainly less war-like than the savage tribes of the north, whom La Salle and Hennepin afterward visited. Whether they were the builders of the works now existing, or were occupying the works of another people who preceded them, they were in the agricultural state. The massiveness of the pyramids or platforms of earth, found throughout this region, show that a sedentary people, who had long followed the peaceful pursuit of agriculture, and who had reached a high degree of architectural skill, had lived here. And so, throughout the whole valley of the Mississippi the evidênces are accumulating that there was a stage of society, once existing here, quite different from that which ever prevailed among the savage tribes.

These savage tribes did indeed follow the agricultural life to a certain extent, and some of them reached a high state of development. The history of the Iroquois confederacy records the facts that there was not only a high state of political and social life among them, but that agriculture and architecture also reached some degree of development; but the description of their works by history, and especially as seen in the fragmentary ruins left by them, would indicate that the Mound Builders were far in advance in all these respects. If we can look at the amount of toil necessary to erect the great earthworks which are scattered over the country, we must ascribe to the Mound Builders an industry which never existed among the later Indians. It is said that the Mound of Cahokia covered an area of six acres, and its solid contents have been estimated at 20,000,000 cubic feet. It was 705 feet in length and the same in width, and rose to a height of 90 feet. It was built in two stories, the lower terrace having a breadth of 160 feet and length of 300 feet, and the upper terrace or summit affording a platform of 200 by 450 feet. [The Great Pyramid of Ghizeh is only 720 feet square, but has a height of 450 feet.] This is only one of sixty similar mounds which are found in the same locality. The great mound at Miamisburg is 68 feet in height and 852 feet in circumference, and contains 311,353 cubic feet. It is said that the mound was built as an observatory and overlooks the Big Twin river. It is situated on a hill just east of the Great Miami, and not only commands a view of the whole valley of the river, but a beacon on its summit can be seen from another high mound in Butler county and from one at Springboro, and from the works at Ft. Ancient. The Grave Creek Mound is 70 feet in height and nearly 1,000 feet in circumference at its base. It was built, evidently, as a sepulchral mound; two vaults having been found in it, which contained at the time it was opened over 3,000 shell beads, several bracelets of copper, various articles carved in stone and a number of ornaments. A stone mound once existed near Newark, O., made up of stone laid up without cement, 52 feet high and a circular base of 182 feet in diameter. During the year 1831–32 not less than 50 teams were employed in hauling stone from it, and carried away from 10,000 to 15,000 wagon loads. The Big Mound in St. Louis was 150 feet in length and 30 in height. Within this was also a sepulchral tomb, 8 to 12 feet wide, 75 feet long and 8 to 10 feet in height, in which from twenty to thirty burials had taken place. The great mound at Seltzertown, Mississippi, is in the form of a truncated pyramid, about 600 by 400 feet at its base, and covering nearly six acres of ground. It is placed to coincide with the cardinal points, its greater length being from east to west. It is 40 feet high, and reached by a graded way leading to a platform on the summit, whose area is four acres, and from which rise three, conical, truncated mounds, about 40 feet in height, and eight smaller ones.

The Messier Mound, Early county, Ga., is in the form of the frustum of a rectangular pyramid, 66 by 156 feet at the summit, which is a level plane. The base measures, northern side, 188 feet; southern side, 198 feet; eastern and western sides, 324 feet each. This tumulus contains 75,000 cubic yards of earth, and would weigh from 90,000 to 100,000 tons, to remove which, by modern means, would cost $50,000, under the same conditions that would require the labor of 1,000 savages one year with the aid of baskets, etc., for the transfer of the earth.

In speaking of these latter mounds, Hon. C. C. Jones says: "Upon even a cursory examination of these groups of mounds with their attendant ditches, earth-walls and fish-preserves, it is difficult to resist the impression that they are the remains of

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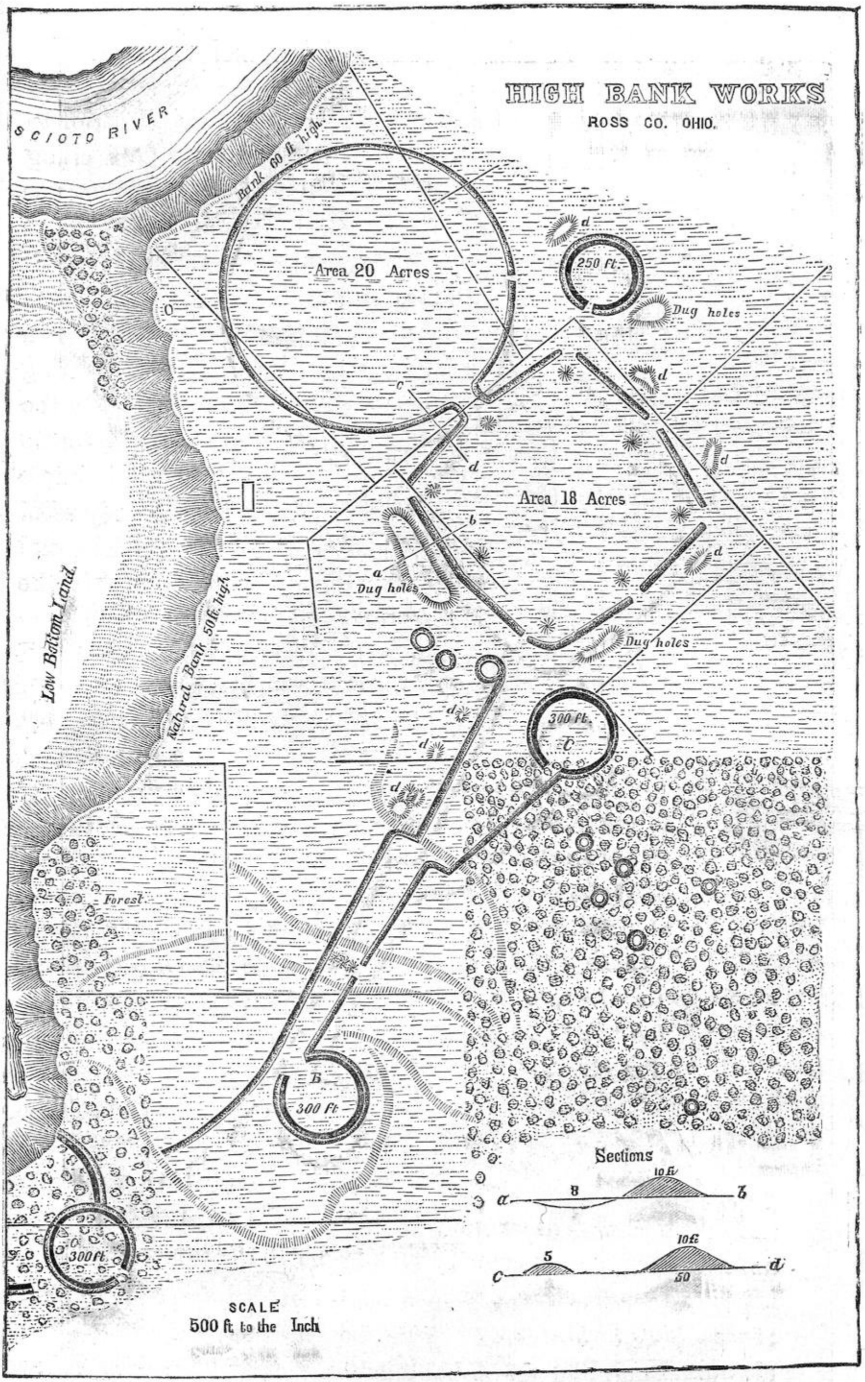
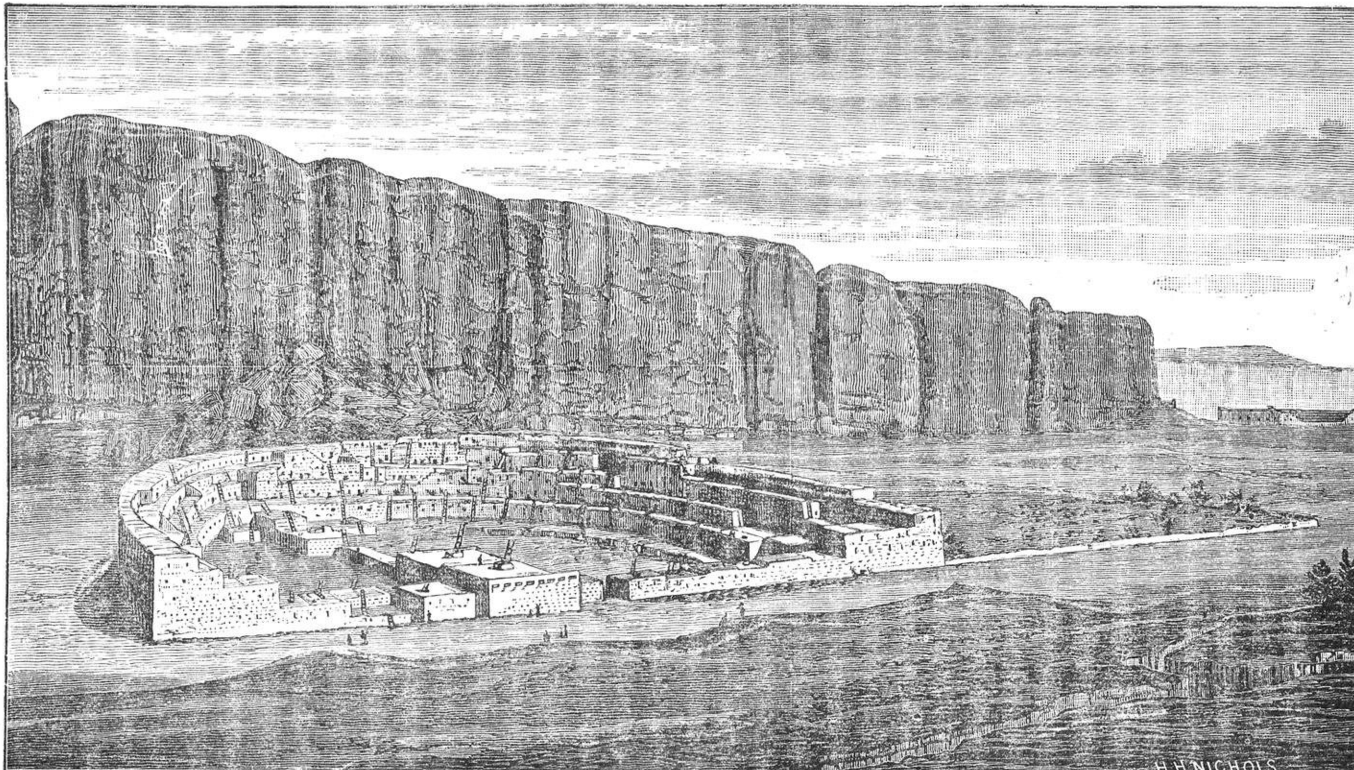
a people more patient of labor, and, in some respects, superior to the nomadic tribes which, within the memory of the whites, clung around and devoted to secondary uses these long deserted monuments. There is not a considerable stream within the limits of Georgia in whose valleys tumuli of this sort are not to be found. They appear in Florida and are frequent in Alabama, where truncated pyramids are even more abundant. Tennessee, South Carolina, Mississippi and Louisiana are dotted with interesting monuments of this class. The occupation of this region by the Mound Builders was by no means inconsiderable. It is in fertile valleys and upon alluvial river-flats, whose soil afforded ample scope for agricultural pursuits, that these tumuli are mainly seen.

There are many works which show the cultus and the social status of the Mound Builders, and these all indicate that the mode of life prevalent among them was entirely different from that which we know to have existed among the ordinary tribes of Indians. The complicated and elaborate system of earth-walls which surround the so-called military, sacred and village enclosures, the various excavations which formed the moats which protected their villages, or ponds for the preservation of fish, the many graded ways which formed the entrances to enclosures, and the many platforms and other structures which were discovered in those enclosures, all show that the society among the Mound Builders had reached a stage where all the varied offices known to civilized life were already common, and where a complete organization had begun to appear. The evidences are, that the Mound Builders were agricultural, and having passed beyond the unsettled condition of the savage races, occupied a position intermediate between the hunter races of the east and the Puebloes of the west, and were also in that social state which formed a connecting link between the two. The term Village Indian has been applied to them, but we maintain that while village life evidently prevailed among them, it was not their distinctive peculiarity. A residence in collected bodies was common throughout all the grades and states. This was owing partly to the communistic state and the tribal organization; but the term Village Indians does not express their status. They were not in that



MOUND BUILDER'S CIRCLE.



PUEBLO OF BONITO.

condition which we know to have prevailed among the Puebloes where the communistic state reached such perfection, and where the social organization was so compacted. Nor were they, on the other hand, mere confederate tribes, who were full of warlike exploits, nomadic in habit, and scarcely out of the hunter state, but they were evidently agricultural, sedentary and thoroughly organized. We quote again from Mr. Jones, who seems to have apprehended the true status of this unknown people: "Why the older Indian tribes should have erected monuments so much more substantial and imposing than those which were constructed by the modern Indians, it is difficult to say. Forming permanent settlements, they devoted themselves to agricultural pursuits erected temples, fortified localities, worshipped the sun, possessed idols, wrought largely in stone, fashioned ornaments of foreign shells, and occasionally of gold, used copper implements, and were not entirely improvident of the future. Such was the fertility of the localities most thickly peopled by them, so pleasant the climate and so abundant the supply of game, that these ancient settlers were in great measure relieved from that stern struggle which, among nomadic tribes and under more inhospitable skies, constitutes the great battle with nature for life.

We present a cut to illustrate one class of works common among the Mound Builders, taken from the work of Squier and Davis, with it we find the following description: "The principal work consists of an octagon and circle, the former measuring 950 feet, the latter 1,050 feet in diameter. * * The walls of the octagon are very bold, and, where they have been least subject to cultivation, are now between eleven and twelve feet in height, by about fifty feet base. The wall of the circle is much less, nowhere measuring over forty or fifty feet in altitude. In all these respects, as in the absence of a ditch, and the presence of the two small circles, this work resembles the Hopeton works." Of the latter, which is nine miles above on the Scioto, they remark that "the walls of the rectangular work are composed of a clayey loam twelve feet high by fifty feet base. * * They resemble the heavy grading of a railway, and are broad enough on top to admit of the passage of a coach."

III. We turn then, in the third place, to consider the architecture of the Pueblos. The name *Pueblo* signifies *village*, and we shall find that village life is better represented by them, than any other people. This life is indeed compact and concentrated, a whole village being often contained in a single house, a house constituting a village. But if a numerous population and the concentration of a large number of families into one locality, constitutes a village, we certainly have the essential feature of village life, here.

Ordinarily the different occupations of villagers are pursued separately. Either the houses will be distinct, or the people who dwell in them will follow these occupations separately, with the places where they labor, removed from their residence. This is so in civilized countries. There is an approach to the Pueblo life in some of our cities, where the blocks of houses are so similar and so connected, and where the people swarm out from apartment which are constructed exactly the same.

Village life is less compact than city life, and we might properly consider that it was the life, which both the later Indians and the earlier Mound Builders pursued. In that case we should class the Puebloes with city architecture, and ascribe city life to the Pueblo Indians. We have preferred, however, to use the term *village* life here, and if we were to ascribe city life to any people, would refer it to those races who have left their ruins to the southwest; i. e. the civilized races of America. There was a necessity for this concentrated life among the Puebloes, as the country which they occupied would not admit of a wide spread population. The mesas which stretch from valley to valley throughout this whole region where the great plateau of North America is found, are barren, rocky and uninhabitable. The only places which admit of settlement and afford the means of living to any number of people, are the valleys of the streams.

Mr. L. H. Morgan says that New Mexico is a poor country for civilized man, but quite well adapted to sedentary Indians, who cultivate about one acre out of every 100,000. The region is composed of valleys which intervene between the mesas, though the cañons here are less abrupt and are wider in extent than in many other places. The cañons grow deeper and more inaccessible as one travels southward. There are places where the level plain between the walls of the cañon range from half a mile to a mile. Such is the cañon of the Rio Chaco in New Mexico. The Anamas and San Juan rivers, which are both tributaries of the Colorado river, contain many puebloes, but are lined with valleys which extend, in places, even to three miles in width. The Montezuma valley is a broad and level plain, 50 miles in length and 10 miles wide. The bluffs bordering the eastern sides rise boldly 1,500 feet. This whole district has great importance as an early seat of village Indian life. The ruins which are found in the valleys of the San Juan, Pine, La Plata, Anamas, Hovenweep rivers and the Rio Dolores, show that this remarkable area has held a prominent place in the first and most ancient development of village life in America. The number of puebloes found in the valleys of these rivers cannot be stated, but from these reports of the United States exploring expedition and other sources, we learn that these pueblos, both ancient and modern, are scattered thickly throughout the whole region. There are at present about twenty pueblos in New Mexico. Beside these there are about seven pueblos of the Moquis, near the Little Colorado. The most important of these are the celebrated villages of the Zunis, those in Santo Domingo, Tusayan, Taos, Jemez, Zia, Jose Miguel. These are at present occupied, and are supposed to be the same places which Coronado visited in 1541, and their present occupants are the descendants of the people who lived in them then. It is probable that some of the houses have stood during the 340 years which have elapsed, and are the same as they were with the exception of a few modern improvements. Mr. L. H. Morgan thinks that the villages of the Zuni are the same as the Seven Cities of Cibola, so noted in history. In the center of a plain, upon a commanding eminence, stands the inhabited Pueblo. Its frontage is upon the river, where but a short distance in the background the mesa terminates in tall cliffs, several hundred feet high. The town is built in blocks, with terraced shaped houses, usually three stories high, in which the lower stories do service as the platform for those above. The town is compactly built, many of the streets passing under the upper stories of houses. The whole is divided into four squares and the houses in each are continuously joined together. Building material is stone, plastered with mud. Near this, two miles to the southeast, situated on an elevated mesa a mile in width, the precipitous descent from which measures 1,000 feet, are the ruins of old Zuni.

Beneath the walls of this antiquated ruin, others of a more ancient city are found, whose walls are six feet thick, the city having perished before the present was begun. It appears then that one type of building prevailed through many ages, the same kind of structure having been erected throughout a very wide district of country. There is, however, a difference in the style of architecture in this region, which is embraced between great ranges of mountains, varying according to the belts of latitude, as much as it is defined and limited, by the longitudinal lines. To the northward, the houses are but one story, and do not differ essentially, from those of the wild Indians. Within certain parallels the houses are of the type before referred to, being built in terraces, and on the level of the plain, undefended, except by their own walls. Farther south, the houses are placed on the niches of the cliffs, and are raised above the valleys, and assume many different shapes. Descriptions of the terraced houses have been given. They seem to have combined all the characteristics of dwelling-houses, of village enclosures and of defense. The upper story is narrower than the one below, so that there is a platform, or landing, along the whole length of the building. The house-tops were used as they are in Oriental countries, as the social gathering places. This terraced form of architecture is the typical one throughout New Mexico, Colorado and Arizona.

The buildings are sometimes straight, with wings running to the front, at right angles, thus forming a rectangular square. Others are built in a semi-circular form with the terraces rising like an amphitheatre around a hollow square. These houses are sometimes three, four or five stories high, and reach great dimensions. The material of which they are constructed is sometimes adobè and sometimes stone. The elevation of these Pueblo

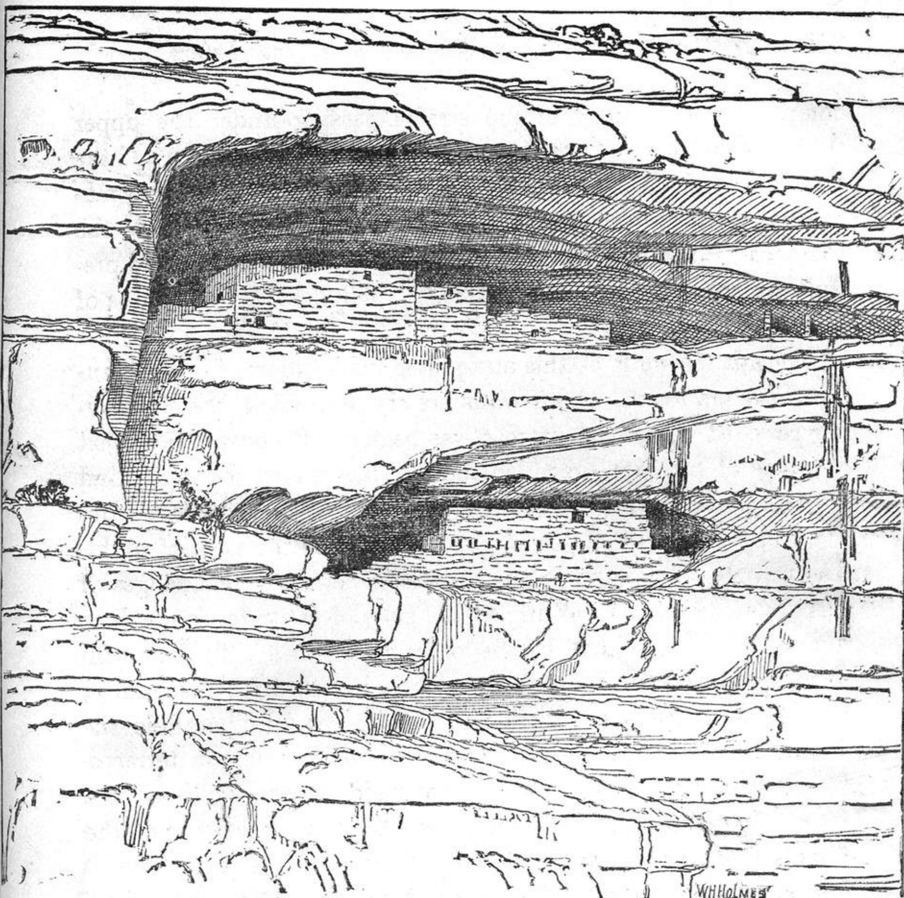


Fig. 1

CLIFF DWELLERS.

Houses, have, from time to time been published. We present herewith, a a restoration of the Pueblo of Bonito, which was published in Morgan's work, and previously in Hayden's Annual Report. This restoration was made by Mr. Simpson, after the study of a large number of houses of the same type. The Pueblo houses varied in size, some having a main building 250 feet in length, some, 300, and some even larger. They are generally erected with wings of proportionate length, and contain oftentimes 120 and 140 rooms. The lower stories were used for storehouses; the upper stories for the residences of the families, and the highest story as the residence of the *cacique* or head man of the village. The walls on the outside were solid and inaccessible: on the inside, toward the court, there were no doors, but the upper stories were reached by ladders which could be taken up, and thus leave the house like a castle, isolated and raised above the plain, and inaccessible. There is no doubt that the communistic system prevailed among the Pueblos.

The cliff-dwellers' dwellings differ from these very much in appearance, and yet they are built on the same plan, and indicate the same mode of life. The residences were not always connected, and village life was not as compact. The inhabitants clung to the cliffs for defense, and scattered their store houses, their *estufas*, and their dwellings along the sides of the precipice and on the edge of the *mesas*, wedging in their abodes wherever a shelter was afforded by the rocks.

The style of architecture prevalent among the cliff dwellers seems to be in great contrast to that prevalent among the Puebloes, but if we analyze and take the component parts of the Pueblo, and then scatter them over the cliffs, we shall find that all the elements are here. Sometimes the *estufa* is placed on the *mesa*, and sometimes it is crowded in between the other chambers under shelter of the cliff. Small rooms are divided off and used for store rooms. The buildings are not often more than one story and lack the terrace form which is peculiar to the Puebloes.

But it is evident that the same mode of life was prevalent in each; the valleys below furnished the provisions for the people, and the inhabitants issued from their rock shelters, just as they did from the many storied Puebloes, to cultivate the soil below, and then transported the products to their store houses, high up among the rocks. The ascent to these cliff houses was sometimes quite difficult, the height at which they were erected being in places several hundred feet. A cliff house visited by W. S. Jackson has a height of 600 feet above the bottom of the cañon, 100 feet of it almost perpendicular wall. The ledge was ten feet wide by twenty feet in length. The same party discovered a cave village, perched up upon a recessed bench, 70 feet above the valley; the total length of the town being 545 feet, with a width in no place more than 40 feet, an *estufa* or council hall being built also into the cliff in the midst of the town; and two rows of rooms also erected in the shelter, the outer row for residences and the inner row for store houses.

On the San Juan river, thirty-five miles below the mouth of the La Plata, and ten miles above the Mancos, Mr. Holmes observed an interesting combination of cave-shelters and towers united in a system for giving signals upon the approach of the enemy. In the face of a vertical bluff 35 feet high, and about half way from the trail below, caves had been quarried or weathered in considerable numbers in the shales which constitute one of the strata in the bluff. A hard platform of rock formed the floor, and afforded sufficient protection for a narrow platform in front of these openings. Immediately above these caves upon this summit of the bluffs, a system of ruined circular towers, enclosed with semi-circular walls, with the open side of the semicircle facing the precipice, was observed. The caves were accessible from the valley below only by means of ladders, and the towers, in turn, only by ladders from the caves, through the open side of their semi-circular enclosures. The walls of these enclosures presented no openings to the plateau above, and it is inferred that the towers which they enclosed served as outlooks, from which the sentinel could signal the people who were engaged in tilling the valley below to flee to their cave-shelters at the approach of the enemy, and when too closely pressed by an enemy upon the plateau, the sentinel himself could make his retreat by means of his ladder to the caves beneath.

The most remarkable cliff-dwellings discovered by Mr. Holmes are shown in the cut.

These extraordinary fortresses, lodged in caves 800 feet above the level of the valley, are situated in the canon of the Mancos, a few miles from its mouth. The first 500 feet of the ascent from the level of the stream is over a rough, cliff-broken slope; the remainder of massive sandstone full of inches and caves. The upper house is situated in a deep cavern with overhanging roof about 100 feet from the cliff's top. The front wall of the house is built upon the very edge of the giddy precipice. The larger house is lodged in a niche or cave 30 feet below. The lower house was easily accessible. The wall was built flush with the precipice, and remained standing to a height of 14 feet at the highest point, though other portions had crumbled away considerably. The house occupied the entire floor of the niche, which measures 60 feet long by 15 wide.

III. We draw this paper to a close, with a few words in conclusion, concerning the architecture of Central America. It was the effort of our distinguished friend, Mr. L. H. Morgan, to take away the glamour and correct the falsehoods which had gathered around the antiquities of this region. It has seemed to us, however, that he went to the other extreme, especially when he represented the ancient inhabitants as Indians, wearing breech-clouts and scarcely different from those whom we know as the "savages" of North America. There may have been indeed many imaginary pictures of the condition of the cities which the Spanish Conquerors entered, but there are enough ruins of these cities to indicate that a barbaric magnificence did prevail there. We are convinced that the national life had begun, for a much higher grade of architecture certainly existed there, and the ruins show that the people had passed out from the village life, into a state which resembles, in many respects, the artificial and magnificent state which is peculiar to civilization. City life may better express the idea than any other term. We do not propose to argue this point, but refer to it and leave it to our readers to decide whether the sculptured and highly adorned buildings were not in fact, as they are called in name, palaces. The communistic mode of life will account for many things, and is a good, working hypothesis, but we cannot class all the pre-historic inhabitants together, and call them Indians, for the works which they have left behind them, and the different grades of architecture seen in these show to us clearly that different modes of life and a different social status prevailed in each geographical district, the grades of architecture being correlated to them.

There has been, in our opinion, too much said about the builders of the pre-historic works being all of them Indians. We might as well talk about the historic works of the east being built by man. One term is about as generic as the other. In Australia the word *natives* denotes the white residents born in the island, but the word *aborigines* signifies the races which were found there. If we could make the distinction between Indians and Aborigines, calling only those Indians who are known to history as the hunters, and savages, and call the rest by some other name, we should be saved a great deal of confusion.

They were, no doubt, all of them Indians and Aborigines, having similar ethnological peculiarities and possibly the same origin. But there was as much difference between these same Indians as between the races of whites. We talk about Irish, Dutch and English, and understand that the social life and architectural taste of these races are very different. But they were not so different as those found among the Indians. In fact, the European races are a good deal nearer to one another, both in territorial proximity, ethnic affinities, and social status, than were any of the native American races. The Europeans have, to be sure, reached the position where property in severalty is held, and where landed estates and family names separate households. The American acres were in that tribal condition, all of them, where the communistic principle prevailed. The tribal organization was universal, but the social status in the different geographical localities and among the different tribes, was very distinct. If America were compared to Europe in the times of Julius Cæsar, this would be better understood. At that time Britons, Gauls, and Goths were occupying the north of Europe. They were the uncivilized races.

The civilized races were found in Italy, Greece and a part of Spain. They were all Indo-Europeans and had a common origin. In fact, they all belonged to the White race. The American aborigines all belonged to the red race. Some were civilized and some uncivilized.

The works of the Britons and of the Iroquois may be compared. The Gauls or Celts may be considered the Mound Builders, or what is better, perhaps, the Iberians. The German tribes may be compared to the Pueblos, and the Romans to the Mexicans. There was a great difference between the Cis-Alpine and Trans-Alpine races. Civilization prevailed at Rome, and much of it was borrowed from the far east. Barbarism prevailed north of the Alps, and the races came from another stock. So the civilization of Mexico and Central America may have been derived from across the water, in one direction or the other. The Aztec, Toltec, and the Chicrinec races may have come from a different stock from the uncivilized races, situated north of Mexico; the grades of society and the stages of architecture were very different, not so different as those which prevailed in Europe, yet different enough to be recognized now in the ruins and monuments. We present a cut with this article which represents one of the palaces which were common in Central America.

Mr. H. H. Bancroft has, in his Native Races of the Pacific Coast, referred to a large number of just such structures. The ruins of Uxmal and Palenque are often described, but these are only types of many which were common. The elaborate carving on the façades of these palaces, the many and complicated halls and chambers which were within, the magnificent corridors and courts which were without, and the whole style of architecture peculiar to the region, show that the people had reached a high stage of development. There must have been a barbaric magnificence which was impressive and strange, and we do not wonder that the Spanish historians represented them in such glowing colors as they did.

Whether evidence will be presented, in the course of time, that this skill and culture were trained by those who had known something of the civilization [of other continents or not, we can not deny that the architecture of this region shows a very different condition of life from that presented elsewhere. The soil and climate may have been favorable, and the increase of wealth and ease may have resulted in just such magnificence without any borrowed skill. But certainly there is a great contrast between these works of the civilized races, and the rude wigwams of the savages. All these different styles and grades of architecture may have had a common origin. Possibly the growth may be traced from the one to the other, but we can no more compare the Montezuma of Mexico to the Hiawatha of the Iroquois, than we can the Julius Cæsar of Rome to the Ariovistus of the Germans.

It is very fashionable to follow an idea, and to imagine that one system will explain them all; but the plain facts disprove all theories. Indian or not, modern or not, the works of Mexico and Central America show that the races there certainly reached a very different state of development from what prevailed north of this region. There is no wonderful mystery about it, and nothing improbable. The Seven Cities of Cibola, situated as they were in the deep inierior of this continent, struck the Spaniards with as much surprise as did the palaces of Mexico. The strange works of the Mound Builders have not yet ceased to excite our wonder and baffle our investigations. Only the familiar and rude ways and works of the Indians excite our contempt. But all of them are important, as showing what different states of society have existed on this continent, and how one dark-skinned, copper-colored race have developed into so many different stages of cultus. We take the four or five classes of architectural works and trace in them four or five different modes of life and social conditions, and so have a picture of the pre-historic ages on this continent which cannot be excelled. The study of primitive architecture is really the main source of information in reference to this age.

PROCEEDINGS OF THE ACADEMY SINCE JULY, 1878.

REPORT OF THE SECRETARY.

NINTH REGULAR ANNUAL MEETING,

Held at Madison, December 27, 28 and 29, 1878, in the Senate Chamber of the Capitol.

FIRST SESSION.

THURSDAY, December 27, 1878.

Academy met at 7:30 P. M., Dr. P. R. Hoy, presiding. Reports from the secretary, treasurer and various committees were read and accepted. Pres. Hoy then delivered his retiring address. After thanking the members for their kindness manifested toward him during his term of office, Dr. Hoy proceeded to briefly relate some of the wonderful discoveries of the recent past, rather than give the usual review of the work of the academy. The labors of Edison, Prof. Draper and various travelers were noticed. Dr. Hoy alluded to the rapid growth of the Academy, which started eight years ago with but eleven members. The address closed with a feeling tribute to deceased members, including the late Prof. Carpenter, whose recent death was severely felt at Madison.

"Did Bacon Write Shakspere?" a paper by Prof. Albert Hardy, of Milwaukee, followed.

The question of the authorship of Shakespere's plays was one of recent growth. Carefully collected facts were introduced to show the high regard which was accorded Shakespere by his contemporaries. The growth of the drama was depicted. A large number of passages taken from Shakespere and Bacon were cited to present the similarities and difference of the two writers. A strict analysis of the style reveals many intricacies of expression, which would escape a less careful scrutiny. From such an analysis the author of the paper was ready to ascribe to Shakespere the authorship of the plays which have immortalized his name.

"The Origin of the Township," a paper by Prof. Allen, of Madison, was read next. It consisted of a brief outline of the history of the organization of townships in France, Germany and England.

After the reading of this paper, a committee was appointed to report on the death of Prof. Carpenter.

Adjourned.

Second Session.

December 28th, 9 A. M

After the election of several new members, Dr. Birge, of the State University, read a paper on "The Theories of Hæckel and Nægeli on Variation.'

Nægeli refers variation to internal forces; Hæckel to external forces exclusively. Neither theory is a complete explanation of the facts. Nægeli offers a teleological explanation as causal, and Hæckel calls in the grotesque conception of the "atom soul" to aid his mechanical forces.

Gov. Smith was introduced to the Academy by Pres. Hoy. Gov. Smith pleasantly responded.

"The Corals of Delafield" was the title of a paper read by I. M. Buel, of Beloit. [See page 185.]

An interesting paper, entitled "Some Observations on the Recent Glacial Deposits of Wisconsin and those of Switzerland," was read by Prof. T. C. Chamberlin, state geologist. The writer correlated the glacial deposits of Wisconsin with those of Switzerland. Stereoscopic views of the glaciers in Switzerland were left at the disposal of the audience.

The meeting adjourned at 12 o'clock.

Third Session.

December 28, 2 P. M.

The afternoon session was opened by a paper relating to "Some Points in the Geology of the Region about Beloit," by Mr. G. D. Swezey, of Beloit College.

The paper following this was entitled "The Penokee Fault," by Prof. R. D. Irving, of the State University.

The description of the "fault" was illustrated by a map showing that the magnetic belt or iron ridge had upon one side of "Bad river" slipped 800 feet below the corresponding ridge on the opposite side. Many interesting facts were noted in connection with this displacement and the various guesses as to the manner in which it had been produced were mentioned.

Prof. Chamberlin next gave a careful and graphic description of the tornado which occurred May 23, 1878, in Western Wisconsin. Prof. Chamberlin was at Mineral Point with a party of explorers, and was able to watch the phases of the storm and study the character of the cyclone. His remarks were verbal, and prefaced the more elaborate description of the same storm in a paper entitled "The Retardation of Wind in Tornadoes," by Prof. Daniells, of the University.

The history of the storm in Wisconsin was only a fraction of its history — its terrestrial career. The signal service had traced its origin to the Pacific coast. Tornado clouds were noticed in Texas, and various meteorological disturbances observed in many regions remote from where the cyclone struck the earth. Along the line of the storm — 65 miles — people who noticed it saw wind clouds moving from various quarters and coming together before spending their fury on the earth, thus giving rise to the idea that it was here that the storm originated. But Prof. Daniells is quite convinced that it was here that it first struck the earth. The storm passed over 128 miles of space in 4 hours time. The velocity was registered at various points along the route and the retardation calculated. The distribution of the debris was noted.

The paper was discussed by Prof. Chamberlin, who took issue with Prof. Daniells' theory of the non-local origin of the cyclone.

The Academy adjourned at 4 o'clock to visit Science Hall, on invitation of Pres. Bascom of the University. This building is admirably adapted for the scientific work for which it has been erected.

Fourth Session.

December 28, 7:30 P. M.

The evening session was opened by the election of officers.

Dr. Chapin, of Beloit, was elected president. A resolution was adopted providing for the immediate election of three vice presidents of the departments of Science, Arts and Letters, respectively, and for the postponement of the election of the remaining department officers until the next meeting.

The following officers were then elected:

Vice President Department of Sciences — Prof. R. D. Irving, Madison.
Vice President Department of Arts — Hon. G. H. Paul, Milwaukee.
Vice President Department of Letters — Dr. G. M. Steele, Appleton.
General Secretary — Dr. J. E. Davies, Madison.
Treasurer — Hon. S. D. Hastings, Madison.
Curator of Cabinet — Prof. G. W. Peckham, Milwaukee.
Librarian — Dr. E. A. Birge, Madison.

A memorial of Dr. J. B. Feuling, written by Dr. S. H. Carpenter, was read by Prof. Allen. This was followed by a paper by Mrs. A. W. Bate of Milwaukee on the "Regime of the Nursery," which indicated the proper regulations for the nursery in order to secure the most beneficial results to young children. The subject was considered under the heads of physical, ethical and intellectual culture. Physical culture is the basis of all; hygienic regulations should be carefully enforced. Ethical culture should be taught by parental example. Responsibility should be gradually given to the child. The very young child should never be crammed with book knowledge. Make home a home.

The following amendment to the constitution was proposed by Prof. Allen and laid over until the next meeting, under the rules:

Resolved, That section 3 of the constitution be amended so as to reduce the number of departments to three, viz.:
Department of Sciences.
Department of Arts.
Department of Letters.

And that the existing amendment to section 3 be repealed.

Adjourned.

Fifth Session.

Madison, December 29.

Academy met pursuant to adjournment. Vice Pres. Steele in the chair.

Dr. E. A. Birge elected secretary *pro tem.*

Report of Committee on the Treasurer's Report made and accepted.

On motion the Academy proceeded to the election of the secretaries of the several departments, the election of the remaining department officers being postponed as by previous arrangement.

The following officers were elected:

Secretary of Department of Arts, Prof. J. J. Elmendorf of Racine.

Secretary of Department of Letters, Prof. W. J. L. Nicodemus of Madison.

Secretary of Department of Sciences, Prof. A. J. Rogers of Milwaukee.

The president, secretary and librarian were constituted a committee to provide for the care of the museum and library with full powers.

Academy adjourned *sine die.*

TENTH REGULAR ANNUAL MEETING,

Held December 29, 30 *and* 31, 1879, *at Madison, in the Senate Chamber of the Capitol.*

First Session.

Madison, December, 29, 1879.

The meeting was called to order by President Chapin at 7 o'clock, P. M. Minutes of last meeting read and approved.

A committee of five was appointed on the revision of the constitution and by-laws of the Academy. Such committee consisted of Prof. J. E. Davies, Prof. E. A. Birge, Prof. J. J. Elmendorf, Prof. T. C. Chamberlin and Dr. P. R. Hoy.

Committee on Nominations was appointed, consisting of three members — Prof. W. C. Whitford, Prof Alex. Kerr, and Hon S. D. Hastings.

Dr. Birge submitted his report as Librarian, and recommended: 1st, that printed labels be procured for the bound volumes and pamphlets of the Academy's library; and 2d, that a printed form of acknowledgment of gifts to the library be secured. Report adopted.

Hon. S. D. Hastings submitted his report as Treasurer as follows:

Treasurer's Office,
Wis. Acad. S. A. and L.,
Madison, Dec. 29, 1879.

Rev. A. L. Chapin, D. D., Pres.:

Sir — The following is a statement of the financial condition of the Academy at this date:

1879.		
Jan. 13.	Received from Gen. Geo. P. Delaplaine, former treasurer	$703 19
Dec. 25.	Received one year's interest on permanent fund..........	70 00
		$773 19

Warrants duly signed by the President and Secretary have been paid as follows:

1879.		
Jan. 24.	To Henry Mason, clerk hire	$12 50
Feb. 1.	To H nry Mason, wrappers, twine, etc.	5 00
1.	To Henry Mason, postage on 100 vols. Trans.	8 00
1.	To David Mason, balance due on account, 1879	8 55
17.	To Henry Mason, postage	8 00
21.	To Democrat Printing Co.	5 25
Mar. 6.	To Henry Mason, expressage	10 00
22.	To Henry Mason, clerk hire	10 00
Apr. 26.	To Henry Mason, clerk hire	12 00
26.	To Henry Mason, expenses	14 25
May 24.	To Henry Mason, package for London	11 00
Sept. 2.	To David Atwood, for programmes	7 50
Oct. 21.	To W. J. Park, binding	43 50
	Total disbursements	$155 64

Total receipts, $773.19; balance on hand, $617.74.

The permanent fund of $1000 was loaned by my predecessor to Messrs. Delaplaine & Burdick for the term of three years from the 1st day of January, 1878.

I hold their two notes of $500 each, secured by mortgage on 23 (twenty-three) improved city lots in Madison.

The notes draw 7 per cent. interest, which has always been promptly paid.

Respectfully submitted.

SAMUEL D. HASTINGS,
Treasurer.

The report was referred to an auditing committee consisting of Messrs Allen, Chamberlain, and Hoy.

The Academy then adjourned to meet in joint session with the State Teachers' Association in the Assembly Chamber. Dr. Chapin delivered an address on the "Nature and Methods of Science, with Thoughts on Teaching Science," before the joint session.

The place to begin teaching science is in the nursery with the child's first efforts at perception. The excellence of the teacher is measured by his ability to inspire enthusiasm. The tools and machinery of the specific branch of science under consideration should be placed in the hands of the student that he may work out for himself the science, aided by hints from his teacher. You cannot pour the conclusions of science into the mind as you would water into a cup.

The time has come when Science is for the masses, and each must rely on his own rational powers. Philosophy has broken the bars of her former seclusion and walks forth in her own native strength and grace, courting the acquaintance and confidence of all, that she may bless all alike, knowing no favorites, except those who draw most largely from her open fountains of truth.

The address finished, the joint session was declared adjourned.

SECOND SESSION.

TUESDAY, December 30, 1879.

The Academy met at 9:30 A. M. in the Senate Chamber.

The following members were elected: Rev. A. A. Young, New Lisbon; F. H. King, River Falls; L. C. Wooster, Whitewater; Prof. H. B. Perkins, Appleton; Prof. C. W. Butterfield, Madison; Prof. R. C. Hindley, Racine; I. M. Buell, Beloit.

Dr. J. J. Elmendorf of Racine College was elected vice-president for the Department of Letters.

Mr. Hastings submitted the following amendment to the constitution:

To amend section 7 of the constitution by adding to division 1 the following:

The names of annual members who are two years in arrears for dues shall be stricken from the roll of members, unless otherwise recommended by the council.

The following preamble and resolutions were then offered by Mr. Hastings and adopted:

WHEREAS: in consequence of there being no penalty prescribed in either the constitution or the by-laws of the Academy for the non-payment of the annual dues of members, and as no adequate provision has been made for the collection of the same, a very considerable number of the members, doubtless through inadvertency, have become largely indebted to the Academy for dues — the indebtedness amounting in some instances to over forty dollars, an amount so large, that to insist upon its payment, would, without doubt, result in the loss of some of our valuable members, therefore be it

Resolved, That in all cases where members are in arrears to an amount exceeding five dollars, including the amount which will be due on the first day of January, 1880, the treasurer be instructed to balance the accounts, carrying forward to new accounts a balance of five dollars, and that he notify at as early a day as convenient, all persons whose accounts have been so adjusted, informing them that on the receipt of said sum of five dollars they will be clear upon the books to the first day of January, 1881.

Resolved, That hereafter it shall be the duty of the treasurer, within thirty days of the close of each regular annual meeting, to notify all members who are in arrears for annual dues, and also, that he report at each meeting of the Academy the names of all members whose accounts are not square upon his books.

WHEREAS: The general secretary, the librarian and the curator of the Museum have duties to perform in connection with their respective offices for which no compensation is provided; therefore be it

Resolved, That the treasurer be instructed to credit the annual dues of the persons holding the offices above named during the period they discharge the duties of their respective offices.

WHEREAS, Several gentlemen who in former years have been active and useful members of the Academy, have removed from the state and cannot, therefore, be expected to continue the payment of their annual dues, and

WHEREAS, It is desirable that some connection be continued between the Academy and the gentlemen referred to, therefore be it

Resolved, That the following named gentlemen, formerly active members of the Academy, be elected as corresponding members: Rev. G. M. Steele, ex-president, Lawrence University; Rev. Bishop Sam'l Fallows, Chicago; Col. S. V. Shipman, Chicago; Judge J. G. Knapp, Florida; Rev. Chas. Caverno, Lombard, Ill.; Rev. F. M. Holland, Massachusetts.

The following amendment to item 1, section 7 of the constitution, was also submitted by Mr. Hastings:

That the fees of annual members be reduced to one dollar.

Prof. Irving read a paper upon the "Higher Scientific Education," urging that it was of the utmost importance that the teacher of each branch should be a specialist in it, even as to the implanting of the *elementary* ideas.

Adjourned.

THIRD SESSION.

December 30, 2: 30 P. M.

The session opened with a paper by Prof. T. C. Chamberlain, on "A New System of Nomenclature in Lithology." [See page 234.] He afterwards lectured in a very interesting manner upon the fossil tracks in the Potsdam Sandstone of Wisconsin. [See page 276.]

Prof. Irving introduced Mr. Magnus Swenson, a student of the University, who read an admirable paper, on "A Syenite from Grand Rapids, Wisconsin," illustrated by a diagram coloured to show the appearance of the Microscopic section of polarized light. This paper was the fruit of much careful original chemical and physical work.

Dr. Hoy read a paper on "Menobranchus Lateralis," illustrated by a specimen. [See page 248.]

A paper on "Miracles in the Light of Modern Science and Philosophy," was read by Dr. J. J. Elmendorf, D. D., of Racine College. [See page 66.]

An able paper on "The Relation of Woman's Suffrage to Society and Domestic Life," was read by Mrs. Olympia Brown Willis, of Racine.

During this session a special session of the Department of Natural Sciences was held at Science Hall, where Prof. R. D. Irving lectured on the "Microscope in Geology," illustrated by the aid of the Calcium light.

Adjourned.

FOURTH SESSION.

December 30, 7: 30 P. M.

The Academy met in joint session with the Teacher's Association in the Assembly Chamber, and listened to a most interesting lecture on "The Arts of Engraving and Etching," by Prof. James McAllister, of Milwaukee, illustrated by numerous examples from the great masters.

Adjourned.

FIFTH SESSION.

December 31, 9 P. M.

Academy met in the Senate Chamber.

Routine business transacted.

The following is the programme of papers read:

"On the Economic Principles of the Distribution of Profits," by Prof. A. O. Wright, Fox Lake. [See page 38.]

"Wealth, Capital and Credit," by Prof. J. B. Parkinson, Madison. [See page 46.]

"Food Adulterations," by I. M. Buell, Beloit.

"The English Cottagers in the Middle Ages," by Prof. W. F. Allen, Madison. [See page 1.]

Adjourned.

SIXTH SESSION.

SENATE CHAMBER, December 31, 2 P. M.

Prof. W. W. Daniells made some remarks on the "Recent Results in the Decomposition of the Elements."

Charles I. King of the University followed on the "Practical Value and Analysis of Indicator Diagrams.

Prof. J. D. Butler presented a paper on the "ἅπαξ λεγομενα of Shakespere." [See page 161.]

Adjourned.

Seventh Session.

December 31, 7:30 P. M.

The academy met in joint session with the Teacher's Association to listen to an exposition of the "Methods of Instruction of the Deaf and Dumb," by W. H. DeMotte, L. L. D., illustrated by class and individual exercises by pupils from the state institute at Delavan.

President Chapin followed with a few remarks, and the meeting adjourned *sine die.*

ELEVENTH REGULAR ANNUAL MEETING,

Held in the Agricultural Rooms of the Capitol, at Madison, December 28, 29 and 30, 1880.

First Session.

Tuesday Evening, December 28, 7:30, P. M.

In the absence of President Chapin, Prof. R. D. Irving, Vice-president of the Department of Sciences, called the Academy to order.

Prof. J. E. Davies, secretary, read the minutes of the previous meeting. Report accepted after a few minor corrections.

Hon. S. D. Hastings submitted his report as treasurer of the Academy, as follows:

Madison, December 28, 1880.

Report of the treasurer of the Wisconsin Academy of Science, Arts and Letters for the year 1880:

1879.			
Dec.	30.	Balance on hand as per last report	$617 64
Dec.	30.	Received from L. C. Wooster	5 00
Dec.	30.	Received from Alex. Kerr	5 00
Dec.	30.	Received from Ira M. Buell	5 00
Dec.	30.	Received from A. L. Chapin	5 00
Dec.	30.	Received from S. D. Peet	5 00
Dec.	30.	Received from A. A. Young	5 00
Dec.	31.	Received from T. C. Chamberlin	3 00
Dec.	31.	Received from P. R. Hoy	5 00
Dec.	31.	Received from D. B. Frankenburger	5 00
Dec.	31.	Received from W. F. Allen	4 00
Dec.	31.	Received from W. C. Sawyer	5 00
Dec.	31.	Received from Lucius Heritage	5 00
1880.			
Jan.	8.	Received from J. B. Pradt	5 00
Jan.	8.	Received from W. A. P. Morris	5 00
Jan.	9.	Received from Jas. S. Buck	3 00
Jan.	9.	Received from J. G. Meacham, Sr	5 00
Jan.	9.	Received from J. G. Meacham, Jr	5 00
Jan.	9.	Received from E. B. Winship	5 00
Jan.	10.	Received from B. E. Hutchinson	5 00
Jan.	10.	Received from W. E. Smith	5 00

1880.		
Jan. 10.	Received from J. Emerson	$5 00
Jan. 10.	Received from Thure Kumlien	5 00
Jan. 12.	Received from Mrs. N. H. Adsit	3 00
Jan. 13.	Received from O. M. Conover	11 00
Jan. 13.	Received from Burr W. Jones	5 00
Jan. 13.	Received from W. C. Whitford	5 00
Jan. 13.	Received from H. S. Orton	5 00
Jan. 13.	Received from J. C. Foye	5 00
Jan. 13.	Received from W. P. McLaren	3 00
Jan. 13.	Received from Chas. A. Farrar	5 00
Jan. 13.	Received from M. H. Simmons	5 00
Jan. 13.	Received from Solon Marks	5 00
Jan. 13.	Received from Mrs. Geo. Gordon	3 00
Jan. 23.	Received from H. B. Perkins	5 00
Jan. 23.	Received from Henry Sneiding	5 00
Jan. 23.	Received from Marion V. Dudley	5 00
Jan. 23.	Received from Delaplaine & Burdick, interest	4 22
Jan. 23.	Received from Delaplaine & Burdick, two notes each $500	1,000 00
Jan. 23.	Received from E. W. Bartlett	5 00
Jan. 28.	Received from Henry Beaty	5 00
Feb. 4.	Received from John Bascom	5 00
Feb. 11.	Received from J. J. Elmendorf	5 00
Feb. 12.	Received from F. H. King	5 00
Mar. 8.	Received from Mrs. Sarah F. Dean	5 00
Aug. 10.	Received from Mrs. O. B. Willis	3 00
Oct. 7.	Received from F. W. A. Falk	5 00
Oct. 19.	Received from R. D. Irving	5 00
Nov. 15.	Received from Jas. D. Butler	5 00
Dec. 9.	Received from W. C. Allen	5 00
Dec. 11.	Received from O. S. Wescott	3 00
Dec. 16.	Received from Mary J. Lapham	3 00
Dec. 16.	Received from Mrs D. A. Olin	3 00
Dec. 17.	Received from Geo. Raymer	5 00
Dec. 18.	Received from F. H. Day	3 00
Dec. 27.	Received from L. C. Draper	5 00
Dec. 27.	Received from R. C Hindley	5 00
Dec. 27.	Received from W. W. Daniells	3 00
Dec. 27.	Received from P. Hendrickson	5 00
	Total receipts	$1,882 86

Disbursements.

Payments on the order of the President and Secretary have been made as follows:

1879.		
Dec. 30.	To Henry Mason (current expenses)	$5 00
Dec. 30.	To Henry Mason (clerk hire)	5 00
1880.		
Dec. 30.	To A. L. Chapin (postage)	1 00
Feb. 5.	To Permanent Fund	1,000 00
Feb. 13.	To E. A. Birge (postage)	2 50
Mar. 18.	To W. J. Park & Co. (binding)	65 25
Mar. 19.	To E. A. Birge (expressage)	1 85
June 7.	To M. J. Cantwell (printing)	12 00
July 2.	To David Mason (expenses)	10 00
Dec. 28.	To Julius Nelson (clerk hire and expenses)	12 20
	Total disbursements	$1,114 80
	Deduct from receipts above leaves balance on hand Dec. 28, 1880.	768 06

Respectfully submitted,

SAMUEL D. HASTINGS, *Treas.*

The report was referred to the Finance committee, consisting of Prof. W. W. Danells, Hon. Burr Jones and Gen. Geo. Delaplaine.

The paper announced for the evening was not read, owing to the absence of the author, Mrs. Willis.

The Academy then adjourned to listen to the address of Pres. Bascom, of the State University, before the state teachers' association.

SECOND SESSION.

Wednesday, December 29, 9:30 A. M.

Academy called to order by the treasurer, Hon. S. D. Hastings, he being the only officer present. On motion of Prof. W. F. Allen, Dr. P. R. Hoy was elected to the chair, and Prof. A. O. Wright elected secretary *pro tem.*

Tne report of Prof. E. A. Birge, librarian, was presented by Julius Nelson, acting librarian, and was adopted.

The following resolution was offered by Hon. S. D. Hastings:

WHEREAS, Prof. J. E. Davies and Gen. Geo. P. Delaplaine have rendered some eight years valuable service to the Academy, the first named as general secretary and the other as treasurer, therefore as an acknowledgment of our appreciation of their faithful labors they are hereby elected life members of the Academy.

The resolution was referred to a committee consisting of Hon. S. D. Hastings, Hon. Burr Jones and Prof. T. C. Chamberlin, who were to report on the legality of adopting the resolution.

Prof. Butler read a paper on "The French Pioneers of the Northwest." [See page. 85.]

Discussed by Prof. A. O. Wright, Prof. W. F. Allen and the chair.

Academy adjourned until 2 o'clock.

THIRD SESSION.

December 29, 2 P. M.

Prof. R. D. Irving in the chair.

Several names were proposed for membership and referred to the committee on Nomination.

A paper was presented by Mr. J. C. Arthur, of the University, on "The True Form of Pollen Grains," to which he appended a paper on "The Various Forms of Trichomes of Echinocystis lobata." Both papers were illustrated by drawings. In the first Mr. Arthur contended that in general the observations upon pollen grains are made when these have lost a considera-able portion of their moisture and are consequently wrinkled. In the second he showed the many and curious forms which the vegetable cell assumes in the hairs or down upon the leaves, stem and fruit of the plant.

Prof. T. C. Chamberlain, of Beloit, state geologist, gave a lecture illustrated by drawings, on "A New Element in the Preliminary Estimates for Artesian Wells."

The professor held that the water contained freely in the microscopic crevices of rocks would, when these lay above the valley, give a resultant pressure which must be recognized in determining the height to which the water would rise in an Artesian well. Prof. J. E. Davies took exceptions to this, maintaining that the capillary attraction would neutralize all the downward pressure. The paper was further discussed by Dr. Hoy, Prof. Irving and Prof. Wooster. Prof. A. O. Wright concluded the diseussion by calling attention to certain metamorphic rocks in Vernon county not noticed in the State Geological Survey.

Prof. T. C. Chamberlain read a paper on "Recent Pseudomorphic and Chemical Changes in the Minerals of the Lead Region" illustrated by specimens. The paper was discussed by Prof. Daniells.

Prof. Daniells reported for the finance committee that the treasurer's report had been audited and found correct.

Report adopted.

A motion was carried that the treasurer be included with those officers who are relieved from their annual dues.

The nominating committee consisting of Hon. S. D. Hastings and Prof. Alex. Kerr, recommended the following persons as annual members: J. M. Olin, Madison; Dr. U. P. Stair, Black Earth; C. F. Viebahn, Manitowoc.

The above named persons were elected.

The following amendment was carried:

To amend item 1, section 7 of the constitution, so that it shall read as follows:

1st. Annual members who shall pay an initiation fee of two dollars and thereafter an annual fee of one dollar.

The following resolutions were adopted:

WHEREAS, The initiation fee for membership has been reduced to two dollars and the annual dues to one dollar, therefore

Resolved, (1) That any person, who in previous years has been elected to membership to the Academy but who has not consummated his or her membership by the payment of the initiation fee, be allowed to do so by the payment of two dollars.

Resolved, (2) That the treasurer be authorized to balance the account of any old member of the Academy to the first day of January, 1882, on the payment of two dollars.

The treasurer was instructed to devise a plan for equalizing the amounts paid by the members as annual dues to conform with the new rules.

Hon. G. H. Paul, vice president, in the absence of the president was requested to make the annual report to the governor of the state.

It was suggested that the letter of the law be more closely adhered to than formerly, viz.: that the report be annual instead of semi-occasional.

FOURTH SESSION.

December 29, 7:30 P. M.

Academy called to order.

Prof. R. D. Irving in the chair.

The Academy listened to a paper by Capt. John Nader, city surveyor of Madison, on the "Tides." The paper was illustrated by numerous drawings and a new co-tidal map. [See page 207.]

FIFTH SESSION.

December 30, 9:30 A. M.

Academy called to order by Dr. J. E. Davies.

On motion of Prof. Butler Dr. Hoy was called to the chair.

Minutes of preceding meeting read and adopted.

The following report of Hon. S. D. Hastings was read and adopted:

The undersigned having been appointed to devise some plan by which the members of the Academy who have been longest in connection therewith and have borne the chief burden of its financial support in the past may be placed somewhat upon an equality with the members now coming into the Academy at the greatly reduced rates for initiation fees and annual dues, would suggest the following:

That the treasurer ascertain the amount paid into the treasury of the Academy by the present members, and also ascertain the amount they would have been required to pay in case the initiation fee and annual dues at the organization of the Academy had been what they now are and then ascertain what each member has paid in excess of what he would have paid had the fees and dues been at the present rate, and that he credit each member on his annual dues for the future one year for each two dollars he has paid in excess as above stated; provided, that in the case of members who are now in arrears in the payment of their annual dues, two dollars shall be deducted from the amount of the excess payment. Respectfully submitted,

S. D. HASTINGS.

A motion was carried to the effect that hereafter the initiation fee be accepted by the treasurer as covering the dues of the new members for the first year.

Hon. O. S. Wescott presented the necessity existing for the appointment of a state entomologist, and introduced the following preamble and resolutions, which were carried:

WHEREAS, The State of Wisconsin suffers annually from the depredations of noxious insects to an extent measured by a loss of not less than fifteen or twenty millions of dollars; and,

WHEREAS, It is the part of the wisest economy to expend money for the prevention, rather than cure; therefore,

Resolved (1), That the Wisconsin Academy of Sciences, Arts and Letters hereby earnestly recommend to the legislature of the state the appointment of some competent scientific person, whose time and service shall be entirely devoted to investigating the insects of the state, and communicating the results of such investigation to the people thereof in the interest of her agriculture, her hortitulture and her forestry.

Resolved (2), That Gen. Geo. E. Bryant, Prof. W. W. Daniells and Hon. S. D. Hastings be requested to act as a committee to take this matter in charge, and secure, if possible, proper legislative action thereon.

To this committee were added Prof. O. S. Wescott and Prof. T. C. Chamberlin.

The secretary and Prof. Wescott were elected a committee to advise with the officers of the State Teacher's Association with regard to joint sessions of that Association and the Academy, or other means of working in common for the advancement of education in the state.

The summer meeting was appointed to be held in Appleton at such a date as would be fixed by correspondence by the secretary.

Prof. A. O. Wright, Prof. J. D. Butler and Prof. J. E. Davies were made a committee on the publication of the proceedings of the Academy.

Dr. Hoy read a paper on the "Hygiene of Drinking Water."

Prof. O. S. Wescott, of Racine, read a paper on the "Orthoëpy and Etymology of Entomological Names."

Discussed by Professors Allen, Wooster, Parkinson and Wescott.

The Academy adjourned *sine die.*

THIRD SEMI-ANNUAL MEETING,

Held at Appleton, Wis., July 5 and 6, 1881.

APPLETON, July 5, 1881.

The Academy met in the College buildings.

In the absence of the president and the vice-presidents, Prof. W. F. Allen was elected president *pro tem.*

In the absence of the secretary, Prof. A. O. Wright was elected secretary *pro tem.*

Prof. Allen and Hon. S. D. Hastings were made a committee on Nominations, to whom were referred several names for membership.

Rev. S. D. Peet of Clinton, delivered an address on "Buffalo Drives among tne Mound Builders," which was illustrated by charts.

APPLETON, July 6, 1881.

Academy called to order.

Acting president Prof. Allen in the chair.

The following persons were elected members: Rev. Stephen Bowen, Clinton, Wis.; Wm. Jones, Clinton, Wis.; W. H. Beach, Beloit, Wis.

Prof. A. O. Wright offered the following resolution, which was adopted:

Resolved, That the Publication Committee be authorized to expend a sum not to exceed eighty dollars for engravings for the forthcoming volume of the transactions in addition to the amount allowed by the state.

The following resolution also offered by Prof. Wright, was adopted:

Resolved, That the librarian be authorized to expend one hundred dollars for binding.

Prof. W. C. Sawyer of Appleton, gave an unwritten address upon the "Phonetic Elements of German," which was discussed by Prof. A. O. Wright and Rev. S. D. Peet.

"The Prehistoric Architecture of America" was the title of a paper read by Rev. S. D. Peet of Clinton. [See page 290.] The paper was discussed by Prof. Wright and Prof. Allen.

The Academy adjourned until the afternoon.

The afternoon session was opened by a paper by W. H. Beach on the "Limits of Thought," discussed by Prof. Wright, Prof. Sawyer, Dr. Hoy and Dr. Meacham.

A paper on "Shakespeare as a Cicerone," by Prof. J. D. Butler of Madison, was read in his absence by Prof. A. O. Wright.

Dr. R. Hoy of Racine, followed with a paper on "The Growth of Trees."

The Academy adjourned *sine die*.

LIBRARY CATALOGUE.

REPORT OF LIBRARIAN.

MADISON, December 29, 1881.

To the President of the Wisconsin Academy:

SIR: I have the honor to submit the following report of the state of the library of the Wisconsin Academy of Sciences at date.

Having been left in charge of the library during the absence of Dr. Birge in Europe, it has fallen to me as clerk of the Academy to prepare a list of the additions to the library since the publication of Vol. IV.

Vol. IV contains a catalogue of the library, but owing to the increase of the library and to the errors, omissions and other faults of this catalogue naturally accompanying a first attempt to bring order out of the chaos of publication in various languages which had accumulated, it was not found a practical guide to the librarian in the distribution of our own publications.

Moreover, many publications had made their way upon the shelves without the knowledge of the librarian, so it became necessary to recatalogue the library. In connection with this work, the publications themselves have been classified and arranged so far as our limited accommodations would admit.

The use of the catalogue to the librarian has been made the primary aim in its preparation. For this reason there remain considerable possibilities of improvement in other directions; but to have made these would have required more labor than could profitably be expended at this time. When the library shall have grown to be the repository of the leading scientific memories of contemporary progress, and our specialists who are able to read all the modern European languages, more numerous, then a catalogue which can be used as a subject-index, will be in order.

That the library may increase healthily, it is essential that the librarian or his clerk, first, receive *all* the gifts sent to the Academy; secondly, that he keep a *journal* of such donations; and thirdly, that he *acknowledge* their receipt. These three points really govern the methods which may be used by the acting librarian, the importance of which can be fully appreciated only by one who has attempted to fulfil the duties of this office. These points have been neglected in a measure and the consequences have been three fold. First, we receive but one-half as much matter as could be received; secondly, many parts which have been sent us are not now upon our shelves. Wherever I could obtain direct knowledge of such fact, the catalogue has been made to include such parts, out of simple justice to the donors. It may be taken as a general rule that where a series is tolerably complete as seen from the catalogue, all was at some time sent us; and thirdly, many societies entitled to them, lack our transactions in whole or in part.

To give an idea of the size of our library which began but ten years ago, I will state that it *crowds* about 100 feet of shelving.

All complete volumes are either bound and labelled or are in process of binding.

The catalogue includes no publications received later than Jan. 1, 1882, at which time new officers, including librarian, had entered upon their duties.

Foreign exchanges are effected through the mediation of the Smithsonian Institution, Washington, D. C.

It is customary with most foreign societies to send with each donation a printed notice and a blank form for acknowledgment, to be returned to the donor signed. I would recommend that with the donations made in connection with this volume, we have something similar printed which shall contain a list of our publications, from which all those parts received by the societies may be checked off. The returned slip will enable us to give said societies its lacking volumes. In this connection, we might also send list of parts lacking in our library to the society concerned.

Respectfully submitted,

JULIUS NELSON, *Clerk for*
E. A. BIRGE, *Librarian.*

PUBLICATIONS OF LEARNED SOCIETIES NOW IN THE LIBRARY OF THE ACADEMY.

DENMARK.

KJÖBENHAVN —

Det kongelige danske Videnskabernes Selskab.

Oversigt over Forhandlingerne, 1874 to 1881. Bul. Soc. danois de la Copenhagne, '76; 1 and 2, '77; 1.

NORWAY.

KRISTIANIA —

K. Norske Videnskabs Selskab og Frederiks Universitet.

Die Culturpflanzen Norwegens — Schübeler, program, Ist Semester, '62.

Remarkable Forms of Deep Sea Life — M. & G. O. Sars, Ist Semest., '69.

Recherches Chronologie Egyptienne — Lieblein, Ist Sem., '72.

Skuringsmaerker — Kjerulf, II Sem., '72.

Egyptischen Denkmaler — Lieblein, I Sem., '74.

Gründtraekkene i den Aeldste Norske Process — Hertzberg, I Sem., '74.

KRISTIANA — continued.

Enumeratio Insectorum Norvegicorum, I to IV; Siebke, Ist Sem., '74 to '77.

Transfusion u. Plethora — Müller, I Sem., '75.

Rem. Forms Animal Life, No. 2, Brisinga,— G. O. Sars, IId S. '75.

Pflanzenwelt Norwegens — Schübbeler, IInd Sem., '75.

Windrosen Südlichen Norwegens —Seue, Ist Sem., '76.

Etudes les Mouvements de l'Atmosphere — I, Guldberg & Mohn, IInd Sem., '76.

Poncelet's Betydning for Geometrien — Holst, I Sem., '79.

Beretning om nogle landbrugschemiske Undersögelser ved Aas höiere Landbrugsskole — Rosing, 1870.

Det Norske Landbrugs Historie, 1815 to 1870 — Smitt, '76.

Stratifikationens Spor — Kjerulf, 1877.

RuneIndskriften paa Ringen i Forsa Kirke — Bugge, '77.

Department for det Indre.

Aarberetning, Landbrugets Fremme, 1875.

Indberetninger, 1858, 1864.

Norges Officielle Statistic, No. 6. Landbrugskolen i Aas, 1868–70.

Beretning om Landbrugskolen i Aas, 1870–71.

Beretning om Landbrugskolen i Aas, 1871–2.

Beretning om Landbrugskolen i Aas, 1874–5.

Polyteknisk Tidskrift —Törkehus for Korn — Dahl, 1867.

Rugekasser for smaafugle — Collett, 1870.

Beretning fra Agronom — T. Wiel, 1855.

Les Peches de la Norwege — Baars, Expos. Univ. Paris, 1867.

Beretning om Ladegaardsoens Hovedgaard, '62–3.

Anden Beretning om Ladegaardsoens Hovedgaard, I, 72; II, 75.

Meteorologiske Institut.

Norges Vind og Storm Statistik — Prof. H. Mohn, 1869.

Den Norske Nordhavsexpedition, 1876–78. (Editorial Committee for.)

Chemi, Tornöe.

Zoologi, Fiske, Collett.

Gephyrea, Danielssen og Koren.

SWEDEN.

STOCKHOLM —

K. Svenska Vetanskaps Akademi.

Öfversigt öfver Forhandlingarne, XXXIII, 1876.

Bihang til Handlingarne, III, '76.

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John's Hopkins University, Baltimore, Md.

U. S. Fish Commisson.

Videnskabernes Selskab, Throndhjem, Norway.

Charles B. Cory, Boston.

Museum at Bergen, Norway.

Biological Society, Washington, D. C.

R. W. Shufeldt, Washington, D. C.

North of England Institute of M. & M. Engineers, New Castle on Tyne.

Royal Society of Canada, Toronto.

Constant Branden Vanden, 69 Rue de la Madeleine, Bruxelles, Belgium.

The authors of the various Government and State Reports and of certain Societies are entitled to receive the Transactions of the Academy.

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Jones, Wm., Clinton, Wis.
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DECEASED MEMBERS.

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McDill, A. S., M. D., Supt. State Hospital for the Insane, Madison, Wis.
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