

"With a modesty that contrasts strongly with the severe language used by PROF. TAIT, he continues :

'To claim priority by insisting on former labors and successes seems to me inadmissible ; but nobody will be able to disclaim an essay, printed with its date in a scientific periodical, since even unpublished papers, if they have their date reliably fixed, are deemed admissible for the purpose.<sup>9</sup>

"And refraining with considerate carefulness from making a direct or even implied charge of plagiarism, such as DUHRING made against HELMHOLTZ and TAIT makes against MAYER, he concludes :

'If a scientist has deposited with an Academy or left with the publisher of some periodical an article with its date in a sealed envelope, he can at any time afterwards prove his claim of priority by opening it ; the second discoverer is, however, then justified in declaring that he had not and could not have had any knowledge of the contents of that letter ; *this he cannot say of a periodical regularly published and accessible to everybody.*<sup>10</sup>

PROF. TAIT commits an error in supposing that the original paper by MOHR was published in Liebig's *Annalen der Chemie*. This is probably due to the fact that in the *Annalen der Pharmacie*, of which MOHR was an associate editor, a short synopsis of his paper appeared under the general heading of a "*Revue für das Jahr 1837.*" (24, 141), bearing the same title, "*Ueber die Natur der Wärme.*" The charge of plagiarism which TAIT distinctly and deliberately makes on the supposed fact that MAYER's essay appeared in the same *Annalen* where MOHR's original paper was printed, can no longer be sustained ; and one may reasonably hope henceforth to hear of it no more. It should never have been uttered.

In conclusion, it may be stated that, in thus presenting for the first time in the columns of "SCIENCE" the complete documentary evidence of Prof. MOHR's priority in regard to the discovery of the great principle of the correlation of forces and the conservation of energy, we have been actuated by no other motive than that which underlies all science, viz.: to seek and proclaim the truth and nothing but the truth, and at the same time to do justice to whom justice is due. And no man deserves more to be accorded an honor which he is entitled to than FRIEDRICH MOHR, whose rare genius and masterly mind never betrayed him into committing such errors of judgment as may be laid at the door of almost every other writer on the subject.

### WYANDOTTE GOVERNMENT,

A SHORT STUDY OF TRIBAL SOCIETY, DELIVERED AT THE BOSTON MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, AUGUST 1, 1880.

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In the social organization of the Wyandottes four groups are recognized, the family, the gens, the phratry, and the tribe.

#### THE FAMILY.

The family, as the term is here used, is nearly synonymous with the household. It is composed of the persons who occupy one lodge, or in their permanent wigwams, one section of a communal dwelling. These permanent dwellings are constructed in an oblong form of poles interwoven with bark. The fire was placed in line along

the centre, and was usually built for two families, one occupying the place on each side of the fire.

The head of the family is a woman.

#### GENS.

The gens is an organized body of consanguineal kindred in the female line. "The woman carries the gens;" is the formulated statement by which a Wyandotte expresses the idea that descent is in the female line. Each gens has the name of some animal, the ancient of such animal being its tutelary god. Up to the time when the tribe left Ohio, eleven gentes were recognized, as follows:

Deer, Bear, Highland Turtle (striped), Highland Turtle (black), Mud Turtle, Smooth Large Turtle, Hawk, Beaver, Wolf, Sea Snake, and Porcupine.

In speaking of an individual he is said to be a Wolf, a Bear, or Deer, as the case may be, meaning thereby that he belongs to that gens ; but in speaking of the body of people comprising a gens they are said to be relatives of the Wolf, the Bear, or the Deer, as the case may be.

There is a body of names belonging to each gens, so that each person's name indicates the gens to which he belongs. These names are derived from the characteristics, habits, attitudes, or mythologic stories connected with the tutelary god.

The following schedule presents the name of a man and woman in each gens as illustrating this statement :

	Indian.	English.
Man of Deer gens	De-wa-ti-re	Lean Deer
Woman " "	A-ya-jin-ta	Spotted Fawn
Man of Bear " "	A-tu-e-tes	Long Claws
Woman of Bear " "	Tsa'-man'-da-ka-e'	Grunting for her Young
Man of Striped Turtle gens	Ta-ha'-so'-ta-ra-ta-se	Going Around the Lake
Woman of Striped Turtle gens	Tso-we-yuñ-kyn	Gone from the Water
Man of Mud Turtle gens	Sha-yan-tsu-wat'	Hard Skull
Woman of Mud Turtle gens	Ya <sup>a</sup> -däsh-shu-räs	Finding Sand Beach
Man of Smooth Large Turtle gens	Hu <sup>n</sup> -'du-cu-tá	Throwing Sand
Woman of Smooth Large Turtle gens	Tsu-ca-e <sup>n</sup> '	Slow Walker
Man of Wolf gens	Ha-ro'-u <sup>a</sup> -yü	One Who goes About in the Dark'a Prowler
Woman " "	Ya <sup>a</sup> -di-no	Always Hungry
Man of Snake gens	Hu-ta-hu'-sa	Sitting in Curled Position
Woman " "	Di-je-rons	One Who Ripples the Water
Man of Porcupine gens	Ha <sup>n</sup> -du-'tu <sup>n</sup>	The One Who Puts Up Quills
Woman of Porcupine gens	Ke'-ya-runs-kwa	Good-Sighted

#### THE PHRATRY.

There are four phratries in the tribe, the three gentes Bear, Deer, and Striped Turtle constituting the first ; the Highland Turtle, Black Turtle, and Smooth Large Turtle the second ; the Hawk, Beaver, and Wolf the third ; and the Sea Snake and Porcupine the fourth.

This unit in their organization has a mythologic basis, and is chiefly used for religious purposes, in the preparation of medicines, and in festivals and games.

The eleven gentes as four phratries constitute the tribe.

Such is the social organization of the Wyandottes.

Each gens is a body of consanguineal kindred in the female line, and each gens is allied to other gentes by consanguineal kinship through the male line, and by affinity through marriage.

To be a member of the tribe it is necessary to be a member of a gens ; to be a member of a gens it is necessary to belong to some family ; and to belong to a family a person must have been born in the family so that his kinship is recognized ; or he must be adopted into a family and become

<sup>9</sup>. Eine Priorität durch Behauptung fruherer Arbeiten und Erfolge beanspruchen zu wollen, halte ich für unzweckmässig. allein eben in einer wissenschaftlichen Zeitschrift gedruckten und mit dem Datum versehenen Aufsatz geltend zu machen wird Niemand zurückweisen können da sogar ungedruckte Aufsätze, wenn sie ein sicheres Datum haben zu diesem Zwecke zugelassen werden. (S. 84.)

<sup>10</sup>. Hat ein Naturforscher bei einer Akademie oder bei dem Herausgeber einer Zeitschrift durch einen verschlossenen Brief Datum genommen, so kann er nachher durch Öffnung des Briefes seine Prioritätsansprüche beweisen ; der zweite Entdecker kann aber dann mit Recht sagen, dass er von dem Inhalte des Briefes keine Kenntniss hatte und nicht haben konnte, das kann er aber bei einer regelmässig erscheinenden und Jedem zugänglichen Zeitschrift nicht sagen. (S. 84.)

a son, brother, or some definite relative; and this artificial relationship gives him the same standing as actual relationship in the family, in the gens, in the phratry and in the tribe.

Thus a tribe is a body of kindred.

Of the four groups thus described, the gens, the phratry and the tribe constitute the series of organic units; the family or household as here described, is not a unit of the gens or phratry, as two gentes are represented in each—the father must belong to one gens and the mother and her children to another.

#### GOVERNMENT.

Society is maintained by the establishment of government, for rights must be recognized and duties performed.

In this tribe there is found a complete differentiation of the military from the civil government.

#### CIVIL GOVERNMENT.

The civil government inheres in a system of councils and chiefs.

In each gens there is a council, composed of four women, called Yu-wai-yu-wá-na. These four women councillors select a chief of the gens from its male members—that is, from their brothers and sons. This gentile chief is the head of the gentile council.

The council of the tribe is composed of the aggregated gentile councils. The tribal council, therefore, is composed one-fifth of men and four-fifths of women.

The sachem of the tribe or tribal chief is chosen by the chiefs of the gentes.

There is sometimes a grand council of the gens, composed of the councillors of the gens proper and all the heads of households and leading men—brothers and sons.

There is also sometimes a grand council of the tribe, composed of the council of the tribe proper and the heads of households of the tribe and all the leading men of the tribe.

These grand councils are convened for special purposes.

#### METHODS OF CHOOSING AND INSTALLING COUNCILLORS AND CHIEFS.

The four women councillors of the gens are chosen by the heads of households—themselves being women. There is no formal election, but frequent discussion is had over the matter from time to time, in which a sentiment grows up within the gens and throughout the tribe that, in the event of the death of any councillor, a certain person will take her place.

In this manner there is usually one, two or more potential councillors in each gens who are expected to attend all the meetings of the council, though they take no part in the deliberations and have no vote.

When a woman is installed as councillor a feast is prepared by the gens to which she belongs, and to this feast all the members of the tribe are invited. The woman is painted and dressed in her best attire, and the sachem of the tribe places upon her head the gentile chaplet of feathers, and announces in a formal manner to the assembled guests that the woman has been chosen a councillor. The ceremony is followed by feasting and dancing, often continued late into the night.

The gentile chief is chosen by the council women after consultation with the other women and men of the gens. Often the gentile chief is a potential chief through a period of probation. During this time he attends the meetings of the council, but takes no part in their deliberations, and has no vote.

At his installation, the council women invest him with an elaborately ornamented tunic, place upon his head a chaplet of feathers, and paint the gentile totem on his face. The sachem of the tribe then announces to the people that the man has been made chief of the gens, and admitted to the council. This is also followed by a festival.

The sachem of the tribe is selected by the men belonging to the council of the tribe. Formerly the sachemship inhered in the Bear gens but at present he is chosen from the Deer gens from the fact, as the Wyandottes say, that death has carried away all the wise men of the Bear gens.

The chief of the Wolf gens is the herald and sheriff of the tribe. He superintends the erection of the council house, and has the care of it. He calls the council together in a formal manner when directed by the sachem. He announces to the tribe all the decisions of the council, and executes the directions of the council and of the sachem.

Gentile councils are held frequently from day to day and from week to week, and are called by the chief whenever deemed necessary. When matters before the council are considered of great importance, a grand council of the gens may be called.

The tribal council is held regularly on the night of the full moon of each lunation and at such other times as the sachem may determine; but extra councils are usually called by the sachem at the request of a number of councillors.

Meetings of the gentile councils are very informal; but the meetings of the tribal councils are conducted with due ceremony. When all the persons are assembled, the chief of the Wolf gens calls them to order, fills and lights a pipe, sends one puff of smoke to the heavens and another to the earth. The pipe is then handed to the sachem who fills his mouth with smoke, and, turning from left to right with the sun, slowly puffs it out over the heads of the councillors who are sitting in a circle. He then hands the pipe to the man on his left, and it is smoked in turn by each person until it has been passed around the circle. The sachem then explains the object for which the council is called. Each person in the way and manner he chooses, tells what he thinks should be done in the case. If a majority of the council is agreed as to action, the sachem does not speak, but may simply announce the decision. But in some cases there may be protracted debate which is carried on with great deliberation. In case of a tie, the sachem is expected to speak.

It is considered dishonorable for any man to reverse his decision after having spoken.

Such are the organic elements of the Wyandotte government.

#### FUNCTIONS OF CIVIL GOVERNMENT.

It is the function of government to preserve rights and enforce the performance of duties. Rights and duties are co-relative. Rights imply duties, and duties imply rights. The right inhering in the party of the first part imposes a duty on the party of the second part. The right and its co-relative duty are inseparable parts of a relation that must be maintained by government; and the relations which governments are established to maintain may be treated under the general head of rights.

In Wyandotte government, these rights may be classed as follows:

First:—Rights of marriage.

Second:—Rights to names.

Third:—Rights to personal adornments.

Fourth:—Rights of order in encampments and migrations.

Fifth:—Rights of property.

Sixth:—Rights of person.

Seventh:—Rights of community.

Eighth:—Rights of religion.

To maintain rights, rules of conduct are established, not by formal enactment but by regulated usage. Such custom-made laws may be called regulations.

#### MARRIAGE REGULATION.

Marriage between members of the same gens is forbidden, but consanguinal marriages between persons of different gentes are permitted. For example, a man may not marry his mother's sister's daughter, as she belongs to the same gens with himself; but he can marry his father's sister's daughter, because she belongs to a different gens.

Husbands retain all their rights and privileges in their own gentes, though they live with the gentes of their wives. Children, irrespective of sex, belong to the gens of the mother. Men and women must marry within the tribe. A woman taken to wife from without the tribe, must first be adopted into some family of a gens other than that to which the man belongs. That a woman may take for a husband a man without the tribe, he must also be adopted into the family of some gens other than that of the woman. What has been called by some ethnologists endogamy and exog-

amy, are correlative parts of one regulation, and the Wyandottes, like all other tribes of which we have any knowledge in North America, are both endogamous and exogamous.

Polygamy is permitted, but the wives must belong to different gentes. The first wife remains the head of the household. Polyandria is prohibited. A man seeking a wife consults her mother, sometimes direct, and sometimes through his own mother. The mother of the girl advises with the women councillors to obtain their consent, and the young people usually submit quietly to their decision. Sometimes the women councillors consult with the men.

When a girl is betrothed, the man makes such presents to the mother as he can. It is customary to consummate the marriage before the end of the moon in which the betrothal is made. Bridegroom and bride make promises of faithfulness to the parents and women councillors of both parties. It is customary to give a marriage feast in which the gentes of both parties take part. For a short time at least, bride and groom live with the bride's mother, or rather in the original household of the bride.

The time when they will set up housekeeping for themselves is usually arranged before marriage.

In the event of the death of the mother the children belong to her sister or to her nearest female kin, the matter being settled by the council women of the gens. As the children belong to the mother, on the death of the father the mother and children are cared for by her nearest male relative until subsequent marriage.

#### NAME REGULATIONS.

It has been previously explained that there is a body of names, the exclusive property of each gens. Once a year, at the green-corn festival, the council women of the gens select the names for the children born during the previous year, and the chief of the gens proclaims these names at the festival. No person may change his name, but every person, man or woman, by honorable or dishonorable conduct, or by remarkable circumstance, may win a second name commemorative of deed or circumstance, which is a kind of title.

#### REGULATIONS OF PERSONAL ADORNMENT.

Each clan has a distinctive method of painting the face, a distinctive chaplet to be worn by the gentile chief and council women when they are inaugurated, and subsequently at festival occasions, and distinctive ornaments for all its members, to be used at festivals and religious ceremonies.

#### REGULATIONS OF ORDER IN ENCAMPMENT AND MIGRATIONS.

The camp of the tribe is in an open circle or horse-shoe, and the gentes camp in the following order, beginning on the left and going around to the right:

Deer, Bear, Highland Turtle (striped), Highland Turtle (black), Mud Turtle, Smooth Large Turtle, Hawk, Beaver, Wolf, Sea Snake, Porcupine.

The order in which the households camp in the gentile group is regulated by the gentile councillors and adjusted from time to time in such a manner that the oldest family is placed on the left, and the youngest on the right. In migrations and expeditions the order of travel follows the analogy of encampment.

#### PROPERTY RIGHTS.

Within the area claimed by the tribe each gens occupies a smaller tract for the purpose of cultivation. The right of the gens to cultivate a particular tract is a matter settled in the council of the tribe, and the gens may abandon one tract for another only with the consent of the tribe. The women councillors partition the gentile land among the householders, and the household tracts are distinctly marked by them. The ground is re-partitioned once in two years. The heads of households are responsible for the cultivation of the tract, and should this duty be neglected the council of the gens calls the responsible parties to account.

Cultivation is communal; that is, all of the able-bodied women of the gens take part in the cultivation of each household tract in the following manner:

The head of the household sends her brother or son into the forest or to the stream to bring in game or fish for a feast; then the able-bodied women of the gens are invited to assist in the cultivation of the land, and when this work is done a feast is given.

The wigwam or lodge and all articles of the household belong to the woman—the head of the household—and at her death are inherited by her eldest daughter, or nearest of female kin. The matter is settled by the council women. If the husband die his property is inherited by his brother or his sister's son, except such portion as may be buried with him. His property consists of his clothing, hunting and fishing implements and such articles as are used personally by himself.

Usually a small canoe is the individual property of the man. Large canoes are made by the male members of the gentes, and are the property of the gentes.

#### RIGHTS OF PERSON.

Each individual has a right to freedom of person and security from personal and bodily injury, unless adjudged guilty of crime by proper authority.

#### COMMUNITY RIGHTS.

Each gens has the right to the services of all its women in the cultivation of the soil. Each gens has the right to the service of all its male members in avenging wrongs, and the tribe has the right to the service of all its male members in time of war.

#### RIGHTS OF RELIGION.

Each phratry has the right to certain religious ceremonies and the preparation of certain medicines.

Each gens has the exclusive right to worship its tutelary god, and each individual has the exclusive right to the possession and use of a particular amulet.

#### CRIMES.

The violations of rights are crimes. Some of the crimes recognized by the Wyandottes are as follows:

- |              |                |
|--------------|----------------|
| 1. Adultery. | 4. Murder.     |
| 2. Theft.    | 5. Treason.    |
| 3. Maiming.  | 6. Witchcraft. |

A maiden guilty of fornication may be punished by her mother or female guardian, but if the crime is flagrant and repeated, so as to become a matter of general gossip, and the mother fails to correct it, the matter may be taken up by the council women of the gens.

A woman guilty of adultery, for the first offence is punished by having her hair cropped; for repeated offences her left ear is cut off.

#### THEFT.

The punishment for theft is two-fold restitution. When the prosecutor and prosecuted belong to the same gens, the trial is before the council of the gens, and from it there is no appeal. If the parties involved are of different gentes, the prosecutor, through the head of his household, lays the matter before the council of his own gens; by it the matter is laid before the gentile council of the accused in a formal manner. Thereupon it becomes the duty of the council of the accused to investigate the facts for themselves, and to settle the matter with the council of the plaintiff. Failure thus to do is followed by retaliation in the seizing of any property of the gens which may be found.

#### MAIMING.

Maiming is compounded, and the method of procedure in prosecution is essentially the same as for theft.

#### MURDER.

In the case of murder, if both parties are members of the same gens, the matter is tried by the gentile council on complaint of the head of the household, but there may be an appeal to the council of the tribe. Where the parties belong to different gentes, complaint is formally made by the injured party, through the chief of his gens, in the following manner:

A wooden tablet is prepared upon which is inscribed the totem or heraldic emblem of the injured man's gens, and a picture writing setting forth the offence follows.

The gentile chief appears before the chief of the council of the offender, and formally states the offence, explaining the picture-writing, which is then delivered.

A council of the offender's gens is thereupon called and a trial is held. It is the duty of this council to examine the evidence for themselves and to come to a conclusion without further presentation of the matter on the part of the person aggrieved. Having decided the matter among themselves, they appear before the chief of the council of the aggrieved party to offer compensation.

If the gens of the offender fail to settle the matter with the gens of the aggrieved party, it is the duty of his nearest relative to avenge the wrong. Either party may appeal to the council of the tribe. The appeal must be made in due form, by the presentation of a tablet of accusation.

Inquiry into the effect of a failure to observe prescribed formalities developed an interesting fact. In procedure against crime, failure in formality is not considered a violation of the rights of the accused, but proof of his innocence. It is considered supernatural evidence that the charges are false. In trials for all offences forms of procedure are, therefore, likely to be earnestly questioned.

#### TREASON.

Treason consists in revealing the secrets of the medicine preparations or giving other information or assistance to enemies of the tribe, and is punished by death. The trial is before the council of the tribe.

#### WITCHCRAFT.

Witchcraft is punished by death, stabbing, tomahawking, or burning. Charges of witchcraft are investigated by the grand council of the tribe. When the accused is adjudged guilty, he may appeal to supernatural judgment. The test is by fire. A circular fire is built on the ground through which the accused must run from east to west, and from north to south. If no injury is received, he is adjudged innocent; if he falls into the fire, he is adjudged guilty. Should a person accused or having the general reputation of practising witchcraft become deaf, blind, or have sore eyes, ear ache, headache, or other diseases considered loathsome, he is supposed to have failed in practising his arts upon others and to have fallen a victim to them himself. Such cases are most likely to be punished.

#### OUTLAWRY.

The institution of outlawry exists among the Wyandottes in a peculiar form. An outlaw is one who by his crimes has placed himself without the protection of his clan. A man can be declared an outlaw by his own clan, who thus publish to the tribe that they will not defend him in case he is injured by another. But, usually, outlawry is declared only after trial before the tribal council.

The method of procedure is analogous to that in case of murder. When the person has been adjudged guilty, and sentence of outlawry declared, it is the duty of the chief of the Wolf clan to make known the decision of the council. This he does by appearing before each clan in the order of its encampment, and declaring in terms the crimes of the outlaw and the sentence of outlawry, which may be either of two grades.

In the lowest grade it is declared that, if the man shall thereafter continue in the commission of similar crimes, it will be lawful for any person to kill him; and if killed, rightfully or wrongfully, his clan will not avenge his death.

Outlawry of the highest degree makes it the duty of any member of the tribe who may meet with the offender to kill him.

#### MILITARY GOVERNMENT.

The management of military affairs inheres in the military council and chief. The military council is composed of all the able-bodied men of the tribe; the military chief is chosen by the council from the Porcupine gens. Each gentile chief is responsible for the military training of the youth under his authority. There is usually one or more

potential military chiefs who are the close companions and assistants of the chief in time of war, and in case of the death of the chief take his place in the order of seniority.

Prisoners of war are adopted into the tribe or killed. To be adopted into the tribe it is necessary that the prisoner should be adopted into some family. The warrior taking the prisoner has the first right to adopt him, and his male or female relatives have the right in the order of their kinship. If no one claims the prisoner for this purpose he is caused to run the gauntlet, as a test of his courage.

If at his trial he behaves manfully, claimants are not wanting, but if he behaves disgracefully he is put to death.

#### FELLOWHOOD.

There is an interesting institution found among the Wyandottes, as among some other of our North American tribes, namely, that of fellowhood. Two young men agree to be perpetual friends to each other, or more than brothers. Each reveals to the other the secrets of his life, and counsels with him on matters of importance, and defends him from wrong and violence, and at his death is chief mourner.

The government of the Wyandottes, with the social organization upon which it is based, affords a typical example of tribal Government throughout North America. Within that area there are several hundred distinct governments. In so great a number there is great variety, and in this variety we find different degrees of organization, the degree of organization being determined by the differentiation of the functions of government and the correlative specialization of organic elements.

Much has yet to be done in the study of these governments before safe generalizations may be made. But enough is known to warrant the following statement.

Tribal government in North America is based on kinship in that the fundamental units of social organization are bodies of consanguineal kindred either in the male or female line: these units being what has been well denominated "gentes."

These "gentes" are organized into tribes by ties of relationship and affinity, and this organization is of such a character that the man's position in the tribe is fixed by his kinship. There is no place in a tribe for any person whose kinship is not fixed, and only those persons can be adopted into the tribe who are adopted into some family with artificial kinship specified. The fabric of Indian society is a complex tissue of kinship. The warp is made of streams of kinship blood, and the woof of marriage ties.

With most tribes military and civil affairs are differentiated. The functions of civil government are in general differentiated only to this extent, that executive functions are performed by chiefs and sachems, but these chiefs and sachems are also members of the council. The council is legislature and court. Perhaps it were better to say that the council is the court whose decisions are law, and that the legislative body properly has not been developed.

In general crimes are well defined. Procedure is formal, and forms are held as of such importance that error therein is *prima facie* evidence that the subject matter formulated was false.

When one gens charges crime against a member of another, it can of its own motion proceed only to retaliation. To prevent retaliation, the gens of the offender must take the necessary steps to disprove the crime, or to compound or punish it. The charge once made is held as just and true until it has been disproved, and in trial the cause of the defendant is first stated. The anger of the prosecuting gens must be placated.

In the tribal governments there are many institutions, customs, and traditions which give evidence of a former condition in which society was based, not upon kinship, but upon marriage.

From a survey of the facts it seems highly probable that kinship society, as it exists among the tribes of North America, has developed from consanguineal society, which is discovered elsewhere on the globe. In fact, there are few tribes that seem scarcely to have passed that indefinite boundary between the two social states. Philologic research leads to the same conclusion.

Nowhere in North America have a people been discov-

ered who have passed beyond tribal society to national society based on property, *i.e.*, that form of society which is characteristic of civilization. Some peoples may not have reached kinship society; none have passed it.

Nations with civilized institutions, art with palaces, monotheism as the worship of the Great Spirit, all vanish from the priscan condition of North America in the light of anthropologic research.

Tribes, with the social institutions of kinship, art with its highest architectural development exhibited in the structure of communal dwellings, and polytheism in the worship of mythic animals and nature-gods, remain.

## THE GENESIS OF CERTAIN IRON ORES.\*

By DR. T. STERRY HUNT, LL. D., F.R.S.

Dr. Hunt began by considering the presence of iron, generally in a ferrous condition, in mineral silicates, in the crystalline rocks, and its liberation therefrom by the sub-aerial decay of these as hydrous ferric oxide. This, as is well known, is, by the agency of organic matter, again reduced to ferrous oxide, which is dissolved in natural waters by carbonic acid or some organic acid, from which solutions it may be deposited either as hydrous peroxide (limonite, etc.) as carbonate (siderite), as silicate, or as sulphide (pyrite, etc.), in all of which forms iron is found in sedimentary deposits. As regards the formation of siderite, he described experiments which show that solutions holding five grammes of ferrous carbonate dissolved as di-carbonate in a litre of water, are spontaneously decomposed in close vessels at the ordinary temperature, and deposit two-thirds of their iron as a white crystalline (hydrated) mono-carbonate, with liberation of carbonic-dioxide. This serves to render more intelligible the reduction and segregation of iron as siderite in earthy sediments, as long since pointed out by W. B. Rogers, for the ores of the coal-measures.

The intervention of soluble sulphates, and their reduction through organic agency to sulphides, determines the formation of sulphide of iron in sediments. The generation of a bi-sulphide (pyrite or marcasite) was then discussed, and it was shown that the ferrous mono-sulphide, which naturally is first generated, may fix a further portion of sulphur and thus form a more stable compound. One example of this is seen when recently precipitated hydrous ferrous sulphide is brought in contact with a solution of a ferric salt, which takes up a portion of the iron, leaving sulphur free to unite with the undecomposed sulphide, and form therewith a very stable higher sulphide of iron. Experiments now in progress lead the writer to believe that sulphur liberated from soluble sulphides may, in a similar manner, unite with ferrous sulphide, and thus help us to explain the generation of pyrites in nature, in the presence of water, at ordinary temperatures.

The changes of siderite and pyrite under atmospheric influences were next considered. The latter by oxidation yields, as is well known, ferrous sulphate. Its frequent conversion by sub-aerial decay into limonite was conceived to be due to the intervention of water, holding carbonates, which, conjointly with oxygen, changes it into hydrous peroxide (limonite), which often retains the form of the pyrites. The transformation of carbonate of iron into hydrous peroxide is a familiar fact.

Limonite ores may thus be produced in three ways. They are sometimes formed by the peroxidation and precipitation of dissolved ferrous salts, as in the so-called bog-ores; but more frequently from the alteration *in situ* of deposits of pyrite or of siderite. Such are the limonites which mark the outcrops of beds or veins of pyrites in the decayed crystalline rocks of the Blue Ridge. The similar ores found in the decayed Taconic schists of the great Appalachian valley can be shown to be due in some cases to the alteration of included pyritous masses, and in others to the alteration of similar masses of siderite, both of which are found in the unaltered Taconic rocks, as, indeed, at various other horizons in the geological series.

If we take the specific gravity of pyrites at 5.0, we shall find that its complete conversion into a limonite of sp. gr.

4.0 would be attended with a contraction of only 2.7 hundredths, while if the limonite have a sp. gr. of 3.6, there would be an augmentation of 10.7 p. c. With siderite of sp. gr. 3.6, on the contrary, its conversion into limonite of the same density would result in a contraction of 19.5 p. c., and into lemonite of sp. gr. 4.0 to a contraction of 27.5 p. c. The evidences of this contraction may be seen in the structure of the limonite derived from siderite. The process operates from the surface of the masses, often resulting in the production of geodes. Their structure will generally serve to distinguish the sideritic from the pyritic limonites.

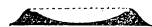
These differences were illustrated in the history of various iron ores in the Appalachian valley, and it was further pointed out that the pyritic limonites, other circumstances being equal, should be freer from phosphorus than those derived from siderite, since the native carbonates almost always contain phosphates, from which pyritous deposits are comparatively free. The source of limonites thus becomes a question of importance to the metallurgist. In conclusion it was pointed out that deposits of manganese ores are, in some cases at least, generated by the alteration *in situ* of manganese carbonates, by a process analogous to that by which limonite is produced from siderite.—

## MICROSCOPY.

### NEW CELL FOR OPAQUE OBJECTS.

I desire to call the attention of the microscopists and preparers of objects generally to the new rubber cell for opaque slides, recently devised by me. A considerable experience in mounting opaque slides during the past few years has convinced me that much of the labor incident to it could be avoided, if a cell of suitable material and shape could be produced at a nominal cost. This, I think, has now been attained, and I take pleasure in submitting one for which I claim convenience, cheapness, and general utility. With it the amateur can produce a slide fully as perfect, and with as great a degree of neatness as can the professional. The cell is of hard rubber, highly polished, and of attractive shape; the base is solid, thus giving a black back-ground of rubber; around the top is a ledge fitted to receive a one-half inch cover glass; this, being secured by a little shellac or any similar cement, completes the mounting. The cell may be attached to a glass slip by any cement, before or after preparation. For exchanges it offers superior advantages, inasmuch as the cell, with objects enclosed, may be sent through the mails independent of the glass slips, the recipient attaching them. In this way a saving is made in postage, and no risk of loss by slips being broken in transit.

They will solve the problem which often perplexes the student or collector who is crowded for cabinet room. Many objects for future reference may be mounted in this simple cell, numbered and put away without a slide, a cabinet drawer holding two hundred of them, while but forty slides could be accommodated in the same space.



The above sectional view conveys a good idea of its shape, the dotted line indicating the position of the thin glass cover.

I have made arrangements to have them supplied by the following firms at thirty cents per dozen, five cents extra on single dozens to cover cost of postage and box, and they may be obtained from the parties mentioned below or from the subscriber. In remitting small sums three cent postage stamps may be used.

GEO. S. WOOLMAN, No. 116 Fulton St., New York; JAS. W. QUEEN & Co., Chestnut St., Philadelphia; BAUSCH & DRANSFIELD, Arcade, Rochester, N. Y.; W. H. BULLOCK, No. 126 So. Clark St., Chicago, Ills.

In conclusion I would add that I have had these rubber cells prepared without regard to any pecuniary gain to myself, hoping they may prove an aid to those engaged in microscopical research.

H. F. ATWOOD,  
No. 50 Hamilton Place, Rochester, N. Y.

[We have seen a sample of Mr. Atwood's rubber cell, and consider it a very perfect arrangement for opaque objects.—ED.]

\* Read before the A. A. S., Boston, 1880.