or cats, the Satanos of Colden and the Shawanons of later writers were one and the same people. These several tribes were then followed with the minutest care, so far as the early writers throw any light upon the subject. The latter part of the paper was a detailed account of the wars, treaties and fortunes of this people from 1755 to the present day. The discussion upon Mr. Royce's communication was particiticipated in by Colonel Garrick Mallery and Major J. W. Powell.

Hr. Hough's paper related to the influence of the inheritance of knowledge and character as making progress in civilization possible. Each individual and each race is the outcome of all those material and psychical causes which have co-operated to bring them into existence. These facts were used by the author to show that the civilization of our race cannot be forced upon another race. By a multitude of examples Mr. Hough illustrated the methods by which the causes which give rise to races and phases of culture are brought together and co-operate to their end. The paper was discussed by Mr. Lester F. Ward, Major J. W. Powell, Professor O. T. Mason and Colonel Garrick Mallery.

THE PRIORITY OF THE LATE FRIEDRICH MOHR IN REGARD TO THE PRINCIPLE OF THE CONSERVATION OF ENERGY.

BY DR. GEO. W. RACHEL.

In an interesting essay entitled, "*On the History of Forces,*" published by DR. C. K. AKIN in the *Philosophical Magazine,*[1] occurs the following passage:

"There has been of late a good deal of controversy regarding the priority of invention or discovery of this last named principle [Correlation of Forces] and it may be interesting, in a historical point of view, to take cognizance of passages of much earlier date than hitherto relied upon as establishing such priority, and upon which I have in the majority of cases rather accidentally lighted."

The controversy alluded to by DR. AKIN in the passage quoted, may be said to have continually attracted the attention of scientists since the above reference was made to it sixteen years ago. It is well known that TYNDALL'S authoritative statement of DR. ROBERT JULIUS MAYER'S priority has been accepted almost universally since it first appeared.

And yet there always was a number of scientific men who held another opinion; but in spite of their protests, even to-day the authority of TYNDALL prevails, and the popular notion all over the civilized world is that MAYER first discovered and proclaimed the great principle in question. This view, however, is erroneous, and in this paper the writer intends to prove, by the introduction of documentary evidence, that the late PROF. FR. MOHR, *of Bonn, was the first who, in clear and unmistakable language, proclaimed the principle of the "correlation of forces" and the "mechanical theory of heat" on which it is based.*

The history of the essay, on which his claim of priority in this matter rests, is a peculiar one, and since the circumstances attending its loss and its re-discovery have had a direct bearing on the controversy in question, they are worth mentioning.

It is certainly a unique occurrence, that a scientist should, for a period of thirty years, have been absolutely unaware of the fact that an article which for the first time in the history of science states a principle of the utmost importance, had actually been published in one of the scientific periodicals to which he sent his MS; and this was due only to the failure, on the part of the publisher or the editor, to transmit a copy of the number containing the paper to the author. But this is what really happened in the case of PROF. MOHR'S article "*On the Nature of Heat.*"

MOHR first sent it to POGGENDORFF, but the latter declined its publication for the peculiar reason that "*it did not contain any new experimental researches.*"[2] It was therefore returned to MOHR and by him, in turn, sent to PROF. BAUMGARTNER, at Vienna, who, at that time (1837), in conjunction with DR. VON HOLGER, published and edited his *Zeitschrift für Physik und Verwandte Wissenschaften.* Not being informed by these gentlemen what had been done with the paper, he supposed it to have been shelved by them on grounds similar to those which prompted POGGENDORFF'S refusal. It was only by an accidental reference to this essay in one of his later works[3] that he chanced to hear of it again.

DR. AKIN wrote to him that it had been published by BAUMGARTNER and VON HOLGER, in the fifth volume of their *Zeitschrift,* etc., p. 419, a passage of it having been quoted by him [DR. A.] in the essay refered to above.

The files of this magazine—which had a very limited circulation—having become scarce, since, shortly after its publication had ceased, the publishing firm was dissolved, it was very difficult to procure a complete set. Thus it was that MOHR had to wait many months until, in response to a request, he received a copy of the volume in question, sent for temporary use only by the librarian of the *Vienna Polytechnic School,* PROF. HLASIWETZ. A letter, accompanying it, contained the following passage:

". . . . I am happy to be able to congratulate you on this important essay, *which puts your priority in regard to the question of the mechanical theory of heat beyond any doubt.* I am glad *furthermore that I should have been* instrumental in the re-discovery of this hidden treasure[4]. . . ."

Very soon after DR. ADOLPH BARTH, of *Leipzig,* the present editor of *Poggendorff's Annalen,* succeeded in hunting up a full set of files of the *Zeitschrift,* etc., and presented them to PROF. MOHR.

Since then the paper in question has been twice re-published in full. The first time by the author himself in one of his later works, with an explanatory statement, containing the history of its loss and re-discovery as given above,[5] and again by DR. HERMANN KLEIN in the seventh volume of his scientific monthly, the "Gæa" in the year 1871.

Although MOHR has never pressed his claim to priority, it is certainly due to his memory that all the facts in connection with it should become fully known. It is always to be regretted, when personal considerations—not to say animosities—come into play in such questions; but it seems as if this very matter had been destined to be the subject of an unceasing feud which has at times even taken the shape of a personal quarrel. Only a few years ago PROF. DÜHRING was 'dismissed' from *Berlin University* by a vote of the faculty, because he had accused PROF. HELM-

[1] Phil. Mag., 4th series., vol. XXVIII., No. 191, December, 1864; pp. 470-477.

[2] For the same reason it was that the editor of the great *Annalen* declined five years later the publication of DR. MAYER'S paper on the same subject, and it therefore appeared in LIEBIG'S *Annalen der Chemie* (42, 240.)

[3] *Mechanische Theorie der chemischen Affinität, Fr. Vieweg; Braunschweig,* 1868.

[4] The letter bears date of Oct. 17, 1868, so that the author received and first saw the article *fully thirty-one years after its publication.*

[5] *Allgemeine Theorie der Bewegung und Kraft, etc. Fr. Vieweg, Braunschweig,* 1869, pp. 80-106.

NOTE.—It is to MOHR, and the fate of this essay, that DR. AKIN refers in a passage contained in his latest letter to PROF. STOKES, which was published in No. 15 of "SCIENCE." On page 179 of this Journal he says: "Another [MOHR] who started similar ideas about the same time, having been repulsed in one quarter (POGG. ANN.) took it for granted that the same had happened to him also in another (B. & v. H. *Ztschr. f. Phys.*, &c.) where it was not the case, so hopeless did he consider his endeavor to obtain a hearing."

It is a strange coincidence that the same humiliating experience was reserved for the last months of the great man's life. For, the last three essays which he wrote, each one of them, abounding in new and original ideas, were also declined by the editors of "LIEBIG'S *Annalen.*" This unwarrantable procedure so disgusted the family of the venerable philosopher that they decided after his demise not to publish them in Germany at all. They have honored the writer by intrusting to him the publication of these valuable essays, and the readers of "SCIENCE" will soon have opportunity to judge, for themselves, of the new and striking views advanced by this great thinker.

HOLTZ of plagiarism (from Dr. MAYER), in the very same matter, and used unbecoming and disrespectful language towards his colleague.

Prof. TAIT also, as our readers are well aware, has re-opened the controversy and has attacked DR. MAYER and his champion, PROF. TYNDALL, in an unnecessarily virulent and aggressive manner.

It is very likely that both these gentlemen would have acted quite differently in this matter had they been informed of the fact that MOHR's priority dates back to 1837. PROF. TAIT only refers to it *in the preface to the second edition of his "Lectures on some recent advances" &c.*,* stating that he had, until very shortly before its publication, not seen or heard of MOHR's writings on the subject, whose indisputable claim to priority he at the same time admits.

In the beginning of this paper we have given the introduction to DR. AKIN's interesting, though as it seems, not very widely known essay, and we shall now proceed to give, in the same order as that adopted by him, the various passages —almost exclusively from MOHR's paper—which DR. AKIN cites in support of his view "that they must invalidate all claims to priority of an earlier date."

DR. AKIN continues (l. c. p. 473):

"The following is an extract from PLACIDUS HEINRICH's: *Die Phosphorescenz &c.*, published in 1872: 'Meanwhile we know, at least with a certain degree of reliability, that nothing is lost in Nature . . . . everything may be explained by constant interchange; the one gains by the loss of the other; the one takes its origin from the disappearance of the other. Therefore there is no such thing as loss in the Universe, only change and interchange.'[1]

The next quotation is from a paper by DR. MOHR, of Koblenz, "*On Heat*," published in 1837:

'Aside from the 54 chemical elements at present [1837] known, there is but one agency in Nature and this we call *Force;* it may under suitable circumstances appear as motion, chemical affinity, cohesion, electricity, light, heat and magnetism, and by means of each of these different forms all the others may be produced. . . . If, by the *force of your arm* you remove an induction-coil from a magnet, an *electric current* will originate in the surrounding spiral wire (helix), which, on being interrupted, appears as a spark, or if the conducting wire is reduced in size, as a glowing wire (*heat and light*); it will also *magnetize* a steel needle if it is conducted through a helix surrounding it; it will decompose the water it passes through, annihilating its *chemical affinity* and its *cohesion* at the same time, and since the thin Platinum-wire, Ampère's helix and the apparatus for the decomposition of water, may be interpolated at the same time in one and the same chain, it is evident that *the force of the human arm may appear under different conditions as heat, light, chemical affinity, magnetism and cohesion.*'[2]

"The passage is followed by two more pages, showing in greater detail the connexion and transmutability of the several known forces and a transcript or translation of which I [Dr. Akin] hope to give at some future occasion. The author concludes his observations with the following judicious remarks:

'Without any doubt all physical phenomena produced by the so-called Imponderabilia may be classified under one of these heads . . . But there remains an immense amount of labor to be done, before, starting from this passing suggestion, we shall arrive at a complete insight into the nature of these things.[3]

"With regard to heat, besides showing that its nature or form is *motion*, which is the principal object of the paper, the writer states (p. 422):

'What . . . annuls (destroys) a force, must itself be a force.'[4]

"And again (p. 422):

'What . . . produces (causes) a force must itself be a force.'[5]

Whence he concludes, considering the effects of heat (p. 421):

'Heat appears as a force in innumerable cases.[6]

"Considering the remarks of Placidus Heinrich as a casual generalization which is found in the writings of other authors of the last century and the beginning of the present (RUMFORD, DAVY, FARADAY and others), and considering furthermore the fact that Mohr's object was to show that heat is not imponderable matter, but consists of the oscillatory motion of ponderable matter, and to prove that this is the case with all the other Imponderabilia so-called, and that because all of the latter, are intro-convertible and convertible into forces, we are justified, nay even forced by irresistible logic to declare all these agencies—forces as well as motions—to be different manifestations of one and the same thing, *it is established beyond any doubt that* FRIEDRICH MOHR *was the first who in clear and convincing language stated the great principles in question.*

"This does, of course, not detract from the merit of MAYER or HELMHOLTZ, or any other author who has arrived independently at similar conclusions, and no one is more ready than MOHR himself to give credit to whom it is due. In the explanatory statement given with the reprint of the essay, he quotes TYNDALL's reference to DR. MAYER's paper mentioned above and indorses the praise contained in it with all his heart. He says:

"I fully accept this statement by TYNDALL. The laying down of *the mechanical equivalent of heat* is one of the principal points in this matter, but it does not exhaust it. MAYER had stated it and calculated it from known facts to be 365 Kilogrammometers. That this figure is not the same we now adopt (424 KM.), does not detract from MAYER's merits in the least; the foremost thing was *to lay down the principle that mechanical motion has its equivalent in heat, that one originates from the other, that both are therefore equivalent to wit: motions.*[7]

"But he continues:

'While thus with all my heart recognizing the great merits of MAYER (and JOULE), I would be unjust towards myself if I should pass in silence over my former writings, which by peculiar circumstances have not become generally known.[8]

**McMillan & Co., London*, 1877.

1. . . . Unterdessen wissen wir wenigstens soviel mit Zuverlässigkeit, dass in der Natur nichts veloren geht . . . alles erklärt sich durch einen steten Umtausch; das eine gewinnt durch Verlust des Andern; das Eine entsteht durch das Verschwinden des Andern. . . . Also im Universum nie Verlust, nur Wechsel und Umtausch. . . . (Vol. II., s. 283.)

2. Ausser den bekannten 54 chemischen Elementen gibt es in der Natur der Dinge nur noch ein Agens und dieses heisst *Kraft;* es kann unter passenden Verhältnissen als Bewegung, chemische Affinität, Cohäsion, Electricität, Licht, Wärme und Magnetismus hervortreten, und aus jeder dieser Erscheinungsarter können alle übrigen hervorgebracht werden . . . Vermöge der Kraft des Armes reisst man die Inductionstrolle von einem Magneten los, es entsteht in dem darum geschlungenen Schraubendrahte ein electrischer Strom, welcher bei Unterbrechung als Funke, oner bei verengerter Leitung als glühender Draht (*Wärme und Licht*) erscheint; derselbe erregt *magnetische Palarität*, wenn er als Schraubendraht um eine Stahlenadel geleitet wird; er zersetzt das Wasser wodurch er geleitet wird, und hebt zugleich seine *Affinität und Cohäsion* auf; und da nun der dünne Platindraht, die Ampèresche Schraube und der Wasserzersetzungsapparat gleichzeitig in derselben Kette eingeschlossen sein können, so leuchtet ein, *wie die Kraft, der Armes unter verschiedenen Verhaltnissen als Wärme, Licht, Chemische Affinität, Magnetismus und Cohäsion zum Vorschein gekommen ist,* (Baumgartner's Zeitschr. f. Physik, &c. Vol. V., s. 442-43.)

* In his reprint, Mohr remarks that at most places where the word "*Kraft*" was used in this first essay, he would now have "*Bewegung.*" —R.

3. Ohne Zweifel lassen sich alle physikalischen Erscheinungen der sogenannten Imponderabilien unter einer dieser Rubriken bringen. . . . Es bleibt aber von dieser flüchtigen Andeutung bis zur vollkommen Einsicht in die Natur der Sache noch unendlich viel zu thun übrig. (s. 445.)

4. Was . . . eine Kraft aufhebt, muss selbst eine Kraft* sein.

5. 'Was . . . eine Kraft hervorbringt, muss selbst eine Kraft sein.

6. Die Wärme erscheint in unzähligen Fällen als eine Kraft.

7. Ich acceptire diese Aeusserung von TYNDALL vollständig. Die Aufstellung *des mechanischen Aequivalentes der Wärme* ist ein Haupttheil der ganzen Lehre, aber es erschöpft sie nicht. MAYER hatte (LIEBIG's *Annalen*, 42, 240) das Aequivalent ausgesprochen und aus bekannten Thatsachen zu Kilogrammometern berechnet. Dass diese Zahl nicht dieselbe ist die wir jetzt annehmen (424 KM.) benimmt dem Verdienste MAYER's nicht das Geringste; *die Hauptsache war die Aufstellung des Satzes dass die mechanische Bewegung ein Aequivalent in der Wärme habe, dass eines aus dem andern entstehe dass beide also gleichartig sind nämlich Bewegung.* (s. 80.)

8. Indem ich die grossen Verdienste MAYER's (und JOULE's) in diesem Zweige der Wissenschaft mit vollem Herzen anerkenne, würde ich gegen, mich selbst eine Ungerechtigkeit begehen, wenn ich nicht meine früheren Arbeiten, die durch einen besondern Umstand nicht zur allgemeinen Kenntniss gekommen sind, stillschweigand übergehen wollte. (s. 82.)

"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.[9]

"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.*[10]

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.

BY MAJOR J. W. POWELL, Director, Bureau of Ethnology, Washington.

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 tutelar 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 tutelar 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^{n}-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^{n}-däsh-shu-räs	Finding Sand Beach
Man of Smooth Large Turtle gens	Hu^{n}'-du-cu-tá	Throwing Sand
Woman of Smooth Large Turtle gens	Tsu-ca-e^{n}'	Slow Walker
Man of Wolf gens	Ha-ro'-u^{n}-yû	One Who goes About in the Dark' a Prowler
Woman " "	Ya^{n}-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^{n}-du'-tu^{n}	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

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9. Eine Prioritat durch Behauptung fruherer Arbeiten and Erfolge beanspruchen zu wollen, halte ich für unzueässig. allein eiaen 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.)

10. Hat ein Naturforscher bei einer Akademie oder bei dem Herausgeber einer Zeitschrift durch einen verschlossenen Brief Datum genommen, so kann er nachher durch Offnung des Briefes seine Prioritätsanspruche beweisen; der zweite Entdecker kann aber dann mit Recht sagen, dass er von dem Inhalte des Briefes keine Kentniss hatte und nicht haben Konnte, *das kann er aber bei einer regelmäs sig erscheinenden und Jedem zugänglichen Zeitschrift nicht sagen.* (s. 84.)