JOHNS HOPKINS UNIVERSITY CIRCULARS

Published with the approbation of the Board of Trustees

VOL. II.—No. 22.] BALTIMORE, APRIL, 1883. [PRICE 10 CENTS.

CALENDAR, 1883.

Tuesday, September 19.	Current Academic Year Began.
Wednesday, May 2.	Meeting of Scientific Association, 8 P. M.
Friday, May 4.	Meeting of Philological Association, 12 M.
Tuesday, May 8.	Meeting of Metaphysical Club, 8 P. M.
Wednesday, May 16.	Meeting of Mathematical Society, 8 P. M.
Friday, May 18.	Meeting of Historical and Political Science Association, 8 P. M.
Monday, June 4—Friday, June 8.	Examinations for Matriculation.
Friday, June 8.	Present Term of Instruction Closes.
Tuesday, September 18.	Next Academic Year Begins.
Tuesday, Sept. 18—Saturday, Sept. 22.	Examinations for Matriculation.
Tuesday, September 25.	Instructions Resumed.

CONTENTS.

SCIENTIFIC NOTES

On the work of members of this University in Mathematics, Physics, Chemistry, Biology, Ancient and Modern Languages, History, Political Science, Psychology, Ethics, and Logic.

NOTES IN PHILOLOGY.

On the General Theory of Greek Accentuation, by M. BLOOMFIELD.

[Abstract of a paper read at the meeting of the University Philological Association, February 2, 1883].

This paper contains a series of historical and critical remarks introductory to a comparative study of Greek accentuation and deals with its subject under six heads.

I. In an introductory chapter the phonetic bearings of the subject are discussed. The main points which are emphasized are first: the distinction between sentence-accent, word-accent, and syllable-accent, and the importance of each of these three in the scientific treatment of the accent of any language. It is shown that sentence-accent especially is just at this time gaining a peculiarly important place in the study of Indo-European grammar. Secondly, it is pointed out how important is the distinction between the chief or summit-accent of sentences and words and their general accentuation, which treats with equal interest the history of pitch and stress in every word of a sentence, and in every syllable of a word.

II. The second chapter is devoted to a discussion of the accentual phenomena of the most important languages of the Indo-European family, and the attempts which have been made, to establish upon the basis of the separate languages a picture of the proethnic Indo-European parent language itself. The views of Benloew and Bopp are subjected to especial criticism, others are passed over lightly. Furthermore the attempt is made to establish certain fundamental principles from which the discussion of the accentuation of any single language must start. Prominent among these is the statement that accentual change must be due to and governed by phonetic law, as much as any other process of change in language. Therefore it must be shown by what laws the peculiar features of Greek accent arose out of the reconstructed Indo-European accentuation. No explanation of the facts of Greek accent which does not connect these with the facts of Indo-European accentuation can be worth much.

III. The third section is devoted to a formulation of the prominent laws of Greek accent within the language itself. Greek accent is largely archaic, *i. e.* it has preserved the prehistoric accent of the parent language; still more largely however the old accentuation has been overrun by a new principle, the "recessive accentuation." It is shown that the well-known laws of this recession are in striking accord with the Greek laws of enclisis, and the ground is taken that this similarity of the laws for enclisis ought to be duly considered in any attempt to explain recessive accentuation.

IV. In this chapter the discussion turns more especially to the Greek. After a review of the literature of the subject the more prominent explanations of Greek accent are considered. After disposing of Göttling's theories, weak even in their day, the very interesting work done by Franz Misteli and James Hadley is discussed and criticized. It is shown how their theory of Greek accentuation, ingenious as it is, fails to hold its ground, when looked at closely. The weakest point in their explanation of the Greek recessive accentuation is this, that they fail to recognize the fact that this accentuation is indigenous with the verb and with the verb only; its extension over other parts of speech is secondary and late.

V. As the theory of Misteli and Hadley draws in the three-syllable accentuation of the Latin a short chapter is devoted to disproving its validity on Latin ground as well as on Greek.

VI. In the last chapter, Jacob Wackernagel's theory of the Greek recessive accentuation is presented and supported. Wackernagel has shown that the Greek recessive accent of the finite forms of the verb is a *substitute for enclisis.* This enclisis was in Indo-European times a quality of the finite verb only in paratactic clauses; in Greek it has become extended to the finite verbs whether in paratactic or hypotactic construction by analogy. Only a few isolated forms of the finite verb have succeeded in preserving orthotonesis by their peculiar character; the entire finite verb has the accentuation of enclitics, which receive an accent, when the word exceeds two syllables or three *morae* according to the laws of "recessive" accentuation.

On the Normal Forms of Early Epistles, by J. RENDEL HARRIS.

[Abstract of a paper read at the meeting of the University Philological Association, February 2, 1883].

The paper assumes the existence of pattern lines of writing among the ancients, viz: the hexameter line and the iambic trimeter, or some submultiple of one of these. From the fact that paper was sold in given sizes, it is highly probable that not only had the lines a model number of syllables, but that the pages had a fixed number of lines.

If this were the case it ought to be possible to determine the size of this normal page of writing from an examination of a given collection of letters. The method adopted was as follows: A collection of letters being taken, the frequency with which letters of any assumed size recurred was tabulated, and it was shown that this frequency must be a maximum for letters just under an integral number of pages of the author, and a minimum when the letter was just over an integral number; because there is a tendency, other things being equal, to finish a letter rather at the bottom of a page than at the top.

The method was first applied to Pliny's letters, with the following result: the normal page of Pliny's writing is between 7.4 and 7.6 lines of the Teubner edition, and represents 20 half-hexameters. Traces were also found of the existence of a smaller page; and the results were applied to the criticism of some lines in Pliny, IV. 11. From this result it followed at once that the separate books of Pliny's letters were, in reality, rolls of 100 sheets apiece.

The method was then applied to the letters of Cicero, with the following results; the commoner type is a letter, a single page of which is represented by 11 Teubner-lines or near it; *i. e.* by 28 half-hexameters, or twice what was designated in a previous paper as a V-page.

A smaller page was also found in not a few instances.

The results were applied to show the manner in which the letters had been reduced into books. Some tests were then applied to the result from the Epistles themselves: such as in Ep. ad Familiares, Book XI. 25, "Non imitor *Λακωνισμὸν* tuum; altera iam pagella procedit," was shown to be the bottom of the first page.

Participial Periphrases in Attic Prose, by W. J. ALEXANDER.

[Abstract of a paper read at the meeting of the University Philological Association, February 2, 1883].

The periphrases treated were those of the present participle with *εἶναι* or *γίγνεσθαι* in the Attic Orators, Plato and Thucydides. Those occurrences in which the participle precedes were first considered, inasmuch as they contain the copular verb in its natural position. It was maintained that the conception which lies at the basis of the verb is that of an activity, and that a participle, when used as such, is as truly a verb as an indicative, and hence presents a definite action to the mind, and predicates. The participle may, however, assume the place and functions of an adjective but by so doing loses the essentials of a verb. The periphrasis under examination is a case of this kind, and in virtue of the transfer of a participle to an adjective, has a function of its own and is differentiated from the corresponding finite forms. It expresses a permanent quality or characteristic without reference to definite acts. (For a clear exhibit of the meaning of the periphrasis see Pl. Euthyph. 9 E. seq., where the argument hinges on the difference between finite and periphrastic forms).

In these combinations, accordingly, the participles most frequently recurring are those of verbs like *προσήκειν* which assert the manifestation of qualities, for the expression of which no corresponding adjectives exist in the language. Next in the order of frequency are participles of verbs which either have lost all notion of activity and have come to express a permanent condition, *e. g.* *ἔχων*, *ὑπάρχων* (Vid. Isoc. Epist. 9. 13; Pl. Rep. 458 A.), or possess a signification that may easily be conceived as a quality, *e.g.* *συνεπόμενος* (Vid. Pl. Critias 117 A.) Thirdly, in such periphrases most rarely are found participles which, though having nothing in their signification that would lead them to be used as adjectives, are nevertheless used in these combinations with a characterizing force, *i. e.* they do not refer to definite acts but are descriptive or express a tendency or capacity (Vid. Dem. 19.37; Pl. Legg. 822 DE). It must be noted that the finite and periphrastic forms are not opposed to one another (Vid. Arist. Physic. 185 b); for the assertion by finite forms of the repeated manifestation of an action or quality may be regarded as a loose equivalent for the assertion, by means of the periphrasis, of the existence of a characteristic or quality in a subject.

Cases of the Second Form, where *εἶναι* or *γίγνεσθαι* precede, were next examined. Here *εἶναι* or *γίγνεσθαι* may take colour again and cease to be a mere sign of predication and thus a new factor is introduced into the complex. The most interesting examples are those where the fullest emphasis is given to *εἶναι*. In such a case, the mind of the speaker dwells on the *εἶναι* and in its signification is to be found the *raison d'être* of the periphrasis (Legg. 692 B; Phaedo, 118 A) and the participle with its characterizing force is merely secondary. The *εἶναι* (or *γίγνεσθαι*) may contain the predicate within itself but the copular force, which lies beneath, enables the participle still to be used as an adjective. (These cases shade off into combinations in which the participle is used as a true participle and which are, consequently, not periphrases; compare Thucy. 8.69.3, 2.80.3 with 2.67.1, 8.92.4.) The differentiation, then, of these periphrases from those of the First Form, as well as from finite tenses, is to be found in the special force of *εἶναι* (or *γίγνεσθαι*). In general the idea expressed is that of an abiding condition. The remaining cases of the Second Form, which comprises the larger number of occurrences, do not differ essentially from those of the First Form, characterization being the prominent idea.

The conception of a quality apart from its manifestation is an abstraction and in practical life not potentially existent tendencies but acts are of prime importance. Hence in every-day speech the periphrases were scarcely, if at all, employed, the finite tenses of continuance answering the purpose. The combination was felt to be harsh, except in the case of adjectivized participles like *πρέπων*. Of this kind are all the participles employed by the Orators in the First Form, except four found in Demosthenes and Lycurgus. A parallel adjective (rarely noun) preceding, as in Dem. 3.25, mediates the use of the participle but even examples of this kind are not common and confined to Isocrates, Aeschines, and Demosthenes, the first named employing only the easiest combinations. As regards the Second Form, the more emphatic and pregnant the *εἶναι* becomes, the easier is the combination, since there is an approximation to the ordinary use of the participle of circumstance. Hence a somewhat wider range of the participles is found in this Form. Thucydides in his usage resembles the Orators. He has no bold combinations, since his method of expressing characteristic is by the use of periphrases containing a noun in *-της*. Plato exhibits great freedom and accuracy in the use of periphrases which are especially numerous in his more abstruse dialogues, as might be expected from the nature of the subject-matter, but the ***Laws*** show a large increase which cannot be accounted for by the theme but marks a change in style.

Note on the above paper, by B. L. GILDERSLEEVE.

At the conclusion of Mr. Alexander's paper Professor GILDERSLEEVE remarked that the investigation had been suggested by the study of Plato's Euthyphron in the Greek Seminary, and expressed his gratification at the results reached by Mr. Alexander.

In the Euthyphron (6 D), Sokrates asks E. for a definition of *τὸ ὅσιον*. Euthyphron's first definition is *τὸ τοῖς θεοῖς προσφιλές* (7 A). Then Sokrates expresses his doubts about this loose way of stating the matter, as the gods are often at variance, and Euthyphron sharpens his definition by saying (9 E): *ἀλλ' ἔγωγε φαίην ἂν τοῦτο εἶναι τὸ ὅσιον ὃ ἂν πάντες οἱ θεοὶ φιλῶσι.* Whereupon, Sokrates, after the usual urbane preface, asks (10 A): *ἆρα τὸ ὅσιον ὅτι ὅσιόν ἐστι φιλεῖται ὑπὸ τῶν θεῶν ἢ ὅτι φιλεῖται ὅσιόν ἐστιν;* "Is *τὸ ὅσιον* loved by the gods because it is *ὅσιον* or is it *ὅσιον* because it is loved?" To which Euthyphron replies, as was expected of him: *οὐκ οἶδ' ὅ τι λέγεις.* Sokrates then proceeds to ask him whether he recognizes certain passive and active participial relations. He entraps him into the statement that *τὸ ὅσιον διὰ τοῦτο φιλεῖται ὅτι ὅσιόν ἐστιν*: and then shows the inconsistency of this with the previous statement. If *τὸ ὅσιον* = *τὸ ὑπὸ τῶν θεῶν φιλούμενον* = *τὸ θεοφιλές* then it is *ὅσιον* because it is loved by the gods; but just the opposite is true and *τὸ ὅσιον* is loved by the gods on account of its lovable nature, or as Sokrates says below (11 A): *ὅτι ἐστὶν οἷον φιλεῖσθαι διὰ τοῦτο φιλεῖται.* The whole argument then turns on the difference between *φιλούμενόν ἐστι* and *φιλεῖται*. This difference is one that must have been patent to every intelligent Athenian just as clearly as the difference between *κνεῖν* and *κνῆσαι* (Symp. 209 A), between *εἶναι* and *γενέσθαι* (Protag. 340 B), just as clearly as any other grammatical point that Plato makes, and Plato's Greek Grammar seems to say "that when the present participle is used in the predicate it becomes an adjective of character or of tendency." In other words, the typical use of the periphrastic does not differ essentially from that of the periphrastic in Latin, in spite of what has been said by grammarians.

The argument is not a subtle one. It shows up the blunder of Euthyphron in giving a statement instead of a definition, which is the trouble with so many of the victims of Sokrates.

In continuation of the subject Professor Gildersleeve said in substance:

"The difference between participle and adjective is a difference in mobility. The adjective is a participle at rest, the participle is an adjective in motion. This difference varies in different languages and in the same language at different periods. A similar difference is seen between the abstract noun and the infinitive. In some languages the abstract noun is as mobile as the infinitive. In Greek it is much more rigid. The difference between participle and adjective is at its height when the participle denotes progressive action, as in the present. In the perfect participle the difference is reduced to a minimum. In Greek the present participle cannot be compared. The perfect participle is compared in *ἐρρωμένος*. In Latin the perfect participle is more readily compared than the present. When the present participle and the adjective are coupled, the adjective regularly takes the participle of the substantive verb. This serves to show the differentiation to the Greek mind. When therefore the present participle is in the predicate it is regularly adjective and no longer denotes progression, development, but character, potentiality. Instructive is the fact that in Latin *qui* with the subjunctive is coupled with the adjective, with the adjectivized participle. ***Res parva dictu sed quae studiis in magnum certamen excesserit. Epaminondas erat temporibus sapienter utens*** (= *qui uteretur*). ***Animalium alia rationis expertia sunt, alia ratione utentia*** (= *quae utantur*). So X. Oec. 7, 2: *ἃ δεόμενά ἐστι—δεῖται* = ***quae egentia sunt—egent.***

"In the *σχῆμα Χαλκιδικόν* the periphrastic was said to have been used for the simple verb (*Σωκράτης ἀπολογούμενός ἐστιν* = *Σωκράτης ἀπολογεῖται*) and there is no denying the later tendency to use the periphrastic as a progressive, but we are now on the territory of the standard language. Aristotle—who is often quoted in this matter (Aristot. Phys., p. 185, *b*. 28, comp. Schol. of Simplic., p. 333, a Bekk., ed. 2, cited by Grote)—says, Metaphys., 4, 7: *οὐθὲν γὰρ διαφέρει τὸ ἄνθρωπος ὑγιαίνων ἐστὶν ἢ τὸ ἄνθρωπος ὑγιαίνει ἢ τὸ βαδίζων ἐστὶν ἢ τέμνων τοῦ ἄνθρωπος βαδίζει ἢ τέμνει.* But what Aristotle means is that so far as the characteristic predication goes there is no difference. *Βαδίζω* involves *βαδίζων εἰμί*."

"Mr. Alexander has also been careful to note, what I have always insisted upon, the importance of position. The copula is often taken in its pregnant sense (*ὄντως ἐστι*), and owing to a disregard of the resumption by the copula of its rights as a verb, we find that Kühner calls *στείχων ἂν ἦν*, Soph. Phil., 1219, (a doubtful passage at best), and *ἐγγὺς τῆς θύρας βαδίζων εἰμί*, Ar. Ran., 35, periphrastic. He might as well have called *εἶναι . . . φυλάττων*, X. An., 1, 2, 21, periphrastic."

"Of course we must take into account the differences of period, differences of locality, differences of individuality. That the participle with the copulative verb should have sunk into a mere periphrasis in the course of time was only to be expected. As for later Greek, there is no telling its eccentricities. Let us first be sure of the classical period."

Studies in Pindaric Syntax, by B. L. GILDERSLEEVE.

[Abstract of a paper in the *American Journal of Philology, No.* 12].

The first of these studies (The Conditional Sentence in Pindar) is based on a paper read before the Johns Hopkins Philological Association (February meeting, 1882), and a summary of it will be found in the *University Circular* for May, 1882, p. 205. The second treats of AN and KEN in Pindar. The following table shows the number and character of the occurrences:

KEN		
Mood and Tense:		
Indic.	Imperf.	1
	Aor.	8
Opt.	Pres.	8
	Aor.	11
Subj.	Aor.	2
Inf.	Pres.	1
	Aor.	1
	Fut.	1
		33
Character:		
Formulated conditionals		8
Half formulated		6
Involved		9
Relative conditional (generic)		1
With subj. as exact future		1
Potential		8
		33

AN		
Mood and Tense:		
Ind.	Aor.	3 (2)
	Fut.	1
Opt.	Pres.	4 (3)
	Aor.	6
Subj.	Pres.	6
	Aor.	10
	Pres. or Aor. according to reading	2
		32 (30)
Character:		
Formulated conditional		1 (0)
Virtual condition		4 (3)
Potential (positive)		4
(negative or equivalent)		4
Relative (generic)		5
Temporal (whenever)		
Pres. of a single time, definite person		3
general of a definite person		2
person and time general		2
Aor. of a single time, definite person		2
general of a definite person		2
person and time general		2
Doubtful (general)		1
		32 (30)

A comparison of these tables shows that ἂν has gained on κέν, if we take Homer as a standard. In the Iliad κέν stands to ἂν as 4 : 1. In the formulated condition (with εἰ) ἂν is not used by Pindar either in protasis or apodosis, and even in so-called virtual conditions ἂν is sparingly employed.

French Syntax as Affected by the Cultivation of Style, by P. B. MARCOU.

[Abstract of a paper read at the meeting of the University Philological Association, March 2, 1883].

An ability to point out the peculiarities of the syntax of a writer or school of writers, is an almost indispensable prerequisite for a true criticism of that writer or school of writers. The very great attention paid to style by French writers, both classic and modern, the keen sense for beauty of expression enjoyed by the whole nation, and the nature of French education whose main aim is the cultivation of a good French style, make it extremely probable that a comparison of the syntax of modern French with the syntax of classic French authors will reveal certain tendencies produced by this persistent cultivation of form in writing. Two qualities which French writers seek to impart to their style are perfect clearness and smoothness, and a liveness or unexpectedness of expression such as may keep the reader's fancy constantly on the alert. The effort to produce the first quality has resulted in a very marked shortening of the length of French sentences. Thus the average number of verbs per sentence in one hundred consecutive Montaigne sentences (the number of verbs in a sentence being taken as a rough indication of its length) is 6.02; in Fénelon, who comes about a century later, this average is 4.48; finally, coming to our time, in Sainte-Beuve it is 3.95 and in Alphonse Daudet, 3.38. Increase in smoothness is shown by a tendency in the more recent writers to make the length of all their sentences approximate much nearer to the length of their average sentence than is the case with the earlier writers.

The effort to produce the second quality of style mentioned has resulted in a more and more nice discrimination between the preposition and the postposition of a certain class of attributive adjectives denoting mostly moral qualities. On the one hand, through a sort of attraction towards the French usage with regard to the majority of adjectives, these adjectives denoting moral qualities have been put more and more frequently after their nouns; on the other hand, when they have been put before their nouns, the motive for doing so, which was at first merely euphony, has been changed in an increasing number of cases into a desire to call forth the fancy of the reader and make it dwell longer on the quality denoted by the epithet, or else to invest the epithet with a vigor or with a mysterious glow which it never possesses when standing in its usual place after the noun. This tendency, is scarcely at all perceptible in Bossuet and La Bruyère, begins to appear in Fénelon and Rousseau, is very marked in Chateaubriand whose preposition of *sacré* is a beautiful instance of it, and finally appears most perfect in Prosper Mérimée.

The persistent cultivation of style among the French has doubtless resulted in developing other peculiarities of syntax which a patient study of French writers will reveal.

On the so-called Dying Alexander of the Uffizi Gallery, by A. EMERSON.

[Abstract of a paper read at the meeting of the University Philological Association, March 2, 1883].

This paper was an attempt to prove the connection of the Florentine head with the Gigantomachia of Pergamum. By the help of a photograph, attitude and expression were analyzed and found to exhibit agony, though lesser in degree, similar in kind to that of the Laocoön. Archaeologists have been unable to come to any satisfactory decision on the subject represented. The writer referred the traditional name of Dying Alexander to a careless misapprehension of Plutarch. Alex. Magn. 4 and Plut. de Al. M. virtute aut fortuna II. 2. The bust presents some features of resemblance to other real and supposed portraits of Alexander, but the possibility of the production by a Greek sculptor of so fanciful a work as a portrait of this pattern was denied. The style of the work, however, justifies ascribing its invention to the last period of Greek Art before the Alexandrine. This would connect it with the schools of Rhodes and Pergamum. Before the late discovery of the great Pergamene frieze, attempts at naming the subject could not be more than guess work. The archaeologist of the German expedition, Conze, was struck by the resemblance to the Alexander of a giant's head of the altar-frieze. See Bericht über die Ergebnisse der Ausgrabungen zu Pergamon, p. 52 and Fig. D. on p. 53. The resemblance is evident, but the cut is too small to allow of a closer consideration, while there is reason to believe that the original of the Uffizi head is to be sought in the missing one of the fallen giant of Plate III. Without any alteration of antique portions, the Alexander head, as presented in a photograph taken from the point of view artistically most advantageous, can be drawn into the wood-cut on this plate. The eyes are then directed towards the aegis of Zeus, of which the effect is observable in the features of the face as well as in the preserved body. Especial stress was laid on the complete artistic parallelism, required by the pendant relation of the Zeus and Athena groups, between the head under consideration and that of the winged giant of Plate IV.

It is a curious confirmation of the theory advanced that Overbeck (Kunstarch. Vorles., p. 137, quoted by Wieseler in Müller's DAK.), seeing in the work the expression of "a sudden, surprising pain," suggested an altogether analogous subject: "Capaneus, at the moment when Zeus' thunderbolt strikes him in the neck and is about to hurl him from the scaling-ladder."

On the Second Mutation of Consonants in French Words of Germanic Origin, by H. C. G. v. JAGEMANN.

[Abstract of a paper read at the meeting of the University Philological Association, February 2, 1883].

The German tribes who settled in France during the 5th and 6th centuries introduced into the French language about 750 Germanic words. Very few of these words show in their present state the characteristics of the High German mutation of consonants, although the fact that the French have taken their name for Germany from Alemania seems to point to Upper Germany as the centre of emigration. The reasons of this apparent incongruity are:

A. On Germanic ground: (1) a large number of words came from Low German, principally Norse and Dutch sources, among others the whole vocabulary of the French seamen. (2) The second mutation of consonants was not accomplished when the majority of German words were introduced into French. This appears especially from the treatment in French of the Low German TH which is regularly rendered by T (thiudisk > O. Fr. tiois, Ital. tedesco, Span. tudesco; tharrjan > Fr. tarir, etc.); showing that TH had not only not yet become D but had not even reached the necessary intermediate stage of TH, as represented in Isidorus.

B. On French ground: (1) The French were unable to pronounce several of the High German consonants, especially the aspirates, and changed CH back into K, and PF, PH into P. (2) The Romance mutation of the medial consonants:

Lat. Ital. muTare > Span. Prov. Port. muDar > Fr. mu^er
" " saPere > " " " saBer > " savoir
" " amica > " " " amiGa > " ami^e

worked in the opposite direction from, and therefore counteracted the effects of, the Germanic mutation.

On a Transposition in Seneca, by J. R. HARRIS.

The method which I recently applied to the case of a transposed passage in the New Testament has an interesting illustration in Seneca, ad Marciam. Madvig (Adversaria Critica, p. 355) pointed out that two passages had been transposed in c. 17, and that the words "Dicit omnibus nobis natura . . . qui tibi nihil certi spoponderunt" (c. 17, 6, 7) should in reality stand after the words "sed humanum est" (c. 17, 1). Almost all such cases of transposition arise from the misplacement of a sheet or sheets in the MS. or papyrus roll of which they form a part. And it follows at once that in all such errors we must have an integral number of pages for each of the two passages concerned in the transposition, and also an integral number of pages for the portion of the book antecedent to the disputed ground. Let us apply these tests to the passages of Seneca just referred to.

Taking the Teubner edition as our standard, we have to carry a passage 12.6 Teubner lines in length to a place 38 lines earlier. Obviously 38 is 12.6×3 very nearly. Assuming 12.6 lines to represent a single page of manuscript, the space through which it has to be moved is three pages. The previous part of the book is 568 lines $= 45.0 \times 12.6$ very nearly.

The error, therefore, arose at the 46th page of the MS., and consisted in placing the 46th page after the 49th. Madvig's criticism is therefore completely confirmed.

In the next place, we may enquire into the stichometric size of the page in question. The average Teubner line being found to be 46.9 letters, or somewhat less, and the average hexameter being about 36 letters, a page of 12.6 Teubner lines is about 16 hexameters.

Finally, the remainder of the book being reckoned, we have for the MS. in which the error was made a roll of very nearly 83 complete pages.

On the Nature and Extent of the Athenian Jurisdiction over their Allies, by C. D. MORRIS.

[Abstract of a paper read at a meeting of the University Philological Association, March 2, 1883].

The text of this paper was Thucyd. i. 77. 1, *καὶ ἐλασσούμενοι γὰρ ἐν ταῖς ξυμβολαίαις πρὸς τοὺς ξυμμάχους δίκαις καὶ παρ' ἡμῖν αὐτοῖς ἐν τοῖς ὁμοίοις νόμοις ποιήσαντες τὰς κρίσεις φιλοδικεῖν δοκοῦμεν.* It was shown that most of the franslators and interpreters are in error, because they explain both clauses to this passage as having reference to the same subject matter. In order to make this possible Boeckh, Grote, and Prof. Goodwin declare that *ξυμβόλαιαι δίκαι* cannot mean *δίκαι ἀπὸ ξυμβόλων*, because the latter involve reciprocity of suing and being sued, whereas the concluding clause of the passage evidently refers to suits which were brought by compulsion in Athenian courts. On the other hand Curtius and Prof. Jowett believe that *ξυμβόλαιαι δίκαι* and *δίκαι ἀπὸ ξυμβόλων* are identical, but extend the meaning of the latter phrase so that it includes all this compulsory jurisdiction of the Attic courts, and thereby is divested of the implication of equitable reciprocity which is properly inherent in it. Much light has been thrown on the whole question by the recovery of various inscriptions which have been subjected to minute scrutiny by Köhler, Fränkel, and most recently by J. M. Stahl. The results reached by him were stated in detail and discussed; and the conclusion was arrived at (1) that suits arising out of commercial dealings (*ex contractu*) between the Athenians and their allies were decided *ἀπὸ ξυμβόλων* on terms of equitable reciprocity, more or less, in the courts of the defendant's city; (2) that suits arising *ex delictis* between Athenian citizens and citizens of allied states were decided in Athenian courts; (3) that suits arising *ex delictis* between citizens of an allied state were tried at first in the local courts, with the provision, however, that, if the sentence were death, exile, or disfranchisement, the condemned person should have the right of appeal to Athens; (4) that at a later time it is probable that the more important of such cases were brought to Athens in the first instance; (5) that ordinary civil cases arising between citizens of an allied city were always decided at home. It was further pointed out that the expressions quoted by the grammarians (as that in Hesychius, *ἐδίκαζον Ἀθηναῖοι ἀπὸ συμβόλων τοῖς ὑπηκόοις καὶ τοῦτο ἦν χαλεπόν*) seem to conflict with the first of the above points, and to deny the reciprocity which was no doubt an essential element in commercial treaties; for if such treaties were observed with perfect equity, it ought to be equally true to say *ἐδίκαζον οἱ ὑπήκοοι τοῖς Ἀθηναίοις*. But these expressions in all probability state only what was the practical result as it was realized by the Greeks; for (1) in most cases Athenians would be the aggressors, and therefore the defendants; and then by the terms of the *ξύμβολα* the suits would be tried at Athens; and (2) since all suits in which Athenians were defendants would be tried at Athens, and those in which they were plaintiffs would be tried in different cities, the judicial range of the Athenian courts must have greatly surpassed that of the courts of any one of the allied cities, perhaps of all of them together. Thus even without any formal infraction of the reciprocity implied by the existence of *ξύμβολα*, the impression may easily have come to exist, which the statements referred to seem to express, that it was the Athenians who decided in accordance with the terms of the several *ξύμβολα* the commercial suits of their subjects.

On ΕΠΙΣΤΗΤΑΙ, (*Π* 243).

Query:

The form *ἐπίστηται* occurs Π 243, in a disjunctive dependent interrogative sentence, where an indicative is necessary. La Roche says nothing about the form; others try to explain it as a subjunctive but that it certainly cannot be. Others admit that it is an indicative but cannot explain the form. G. Meyer in his Gr. Gr. p. 372, says that the strong form *στη* has penetrated into the present middle but cites no parallel examples. Is there no other explanation possible? E. H. S.

Answer:

The form may be a perfect, *ἐπίστηται* =**ἠπίστηται*, the sense of composition having been lost as is shown by *ἠπιστάμην*, *ἠπιστήθην*. Or if the sense of composition is not lost, *ἀπότμηται*, *διακόρισται*, *ἐπίτευκται* Hesych. might be cited. See Curtius, Gr. Verb. II, 144. But these belong to a different sphere of the language. The perfect is used like *οἶδα*, *ἔγνωκα* and that group. B. L. G.

[Scientific Notes Continued].

NOTES IN MATHEMATICS.

On a New Theorem in Partitions, by J. J. SYLVESTER.

[Being the substance of a lecture given at the Johns Hopkins University in the month of March last].

It is a well-known theorem that the number of partitions of n into odd numbers is equal to the number of its partitions into unequal numbers. This equality was seen by Euler to result from the identity

$$(1+x)(1+x^2)(1+x^3)\ldots = \frac{1}{(1-x)(1-x^3)(1-x^5)\ldots}.$$

It may also be proved easily by the method of correspondence. For if we call the partitions of n into odd numbers (repeated or not) the U, and into unequal numbers the V system, any V will be of the form $[V_1, V_2, V_3, \ldots,]$ where V_i is of the form

$$q_i \cdot 2^{\alpha_i},\ q_i \cdot 2^{\alpha'_i},\ q_i \cdot 2^{\alpha''_i}, \ldots,$$

each q being an odd number and all the q's unlike.

Hence writing

$$2^{\alpha_i} + 2^{\alpha'_i} + 2^{\alpha''_i} \ldots = A_i,$$

V is transformable into $A_1q_1, A_2q_2, A_3q_3, \ldots$, which is a member of the U system.

And conversely any U as $A_1q_1, A_2q_2, A_3q_3, \ldots$, will be transformable into a V by decomposing each V into a sum of products of its largest odd divisor into distinct powers of 2 which can be effected in one and only one manner; so that there is a one-to-one correspondence between the U's and V's, and the number of the one set is therefore the same as the number of the other. The theorem which is now to be explained is, so to say, a differentiation (in the Herbert Spencer sense) of this theorem.

It regards the U and V system each broken up into classes and affirms the equality between the numbers of U's in any class and of the V's in the homonymous class. The proof of this by an analytic identity remains to be discovered—it is effected without great difficulty by the method of correspondence: but what is very worthy of notice is that the V which corresponds to a U, in the more refined construction about to be explained is in general (and it may be universally) different from the V which corresponds to it, when the preceding method of conjugation is adopted.

Every U which contains i distinct parts is said to be a U of the ith class, and every V which contains i distinct sequences (not running together) of consecutive numbers is said to be a V of the ith class — and my theorem may be expressed by saying that there exists a one-to-one correspondence (and therefore equality of content) between the U's of any class and the V's of the same class. I ought perhaps rather to say that a correspondence can be *instituted* than that a correspondence *exists*, for the fact that two absolutely unlike bonds of correspondence connect the totality of the U and that of the V system seems to indicate that such correspondence should rather be regarded as something put into the two systems by the human intelligence than an absolute property inherent in the relation between the two. Kant makes a similar remark upon the elementary conceptions, (such as the circle) which form the groundwork of geometry.

As an example of the numerical part of the theorem consider the 3d class of the U's and V's for $n = 16$.

The U's of this class will be

$11.3.1^2$; $9.5.1^2$; $9.3^2.1$; $9.3.1^4$; $7.5.1^4$; $7.3^2.1^3$;
$7.3.1^6$; $5^2.3.1^3$; $5.3^3.1^2$; $5.3^2.1^5$; $5.3.1^8$;

and the V's which are somewhat more difficult to calculate by an exhaustive process will be found to be

1.6.9; 1.2.5.8; 2.6.8; 1.5.10; 1.2.4.9; 2.5.9;
1.4.11; 1.3.4.8; 3.5.8; 2.4.10; 1.3.12.

So again of the 4th class there is only one U and one V, viz., 1.3.5.7, which is common to the two systems — and of the first class owing to 16 containing only one odd division, viz., unity, there is also but one U and one V, viz., the undivided 16 for each alike. In general for the first class the number of U's is obviously the number of odd divisors of the partible number n and the number of single sequences is easily seen to be the same. Thus, *ex. gr.*, for 15 there exist the sequences 1.2.3.4.5; 4.5.6; 7.8; 15; and for 9 the sequences 2.3.4; 4.5; 9.

I will now indicate the mode of proof, the particulars of which will be found set out in full in the forthcoming number of the *American Journal of Mathematics*.

The partible number n being given, I take any U belonging to it and form two graphs, one whose rows represent the major halves of each part of U and the other its minor halves [$q+1$ is the major and q the minor half of $2q+1$]. I then dissect each of these graphs into its component angles and take the content of each; it is easily seen that beginning with the major and passing from it to the minor and back again to the major and so on continually in alternate succession, the readings will form a continually decreasing series of numbers whose sum will be the same as of the parts of the U, and thus U will be transformed into V. The number of parts in V, if we agree to consider that number as always *even* by supplying a zero at the end if it should happen to be *actually* odd, will be $2i$ where i is the number of points in the side of the Durfee-square appertaining to the major graph.

Conversely, if any V be given containing or made to contain $2i$ parts, it is easy to construct a system of $2i$ *linear* equations between the contents of the first i lines and the first i columns of an assumed U having a Durfee-square containing i^2 points which shall transform into the given V, and to prove that these contents will be all of them greater than $2i$: hence *one* and *only one* U corresponds to a V, and consequently there is a one-to-one correspondence between the entire U and entire V systems. It remains to show that any U_i (a U of the ith class) by the prescribed process of transformation becomes a V_i (a V of the ith class).

This is effected as follows: suppose the first exterior angle to be removed simultaneously from a given major graph and its accompanying minor: begin with supposing that U_i becomes V_j: i is the number of unequal lines in either graph and it is easily proved that $i-j$ remains unaltered by the contraction of the graphs in the manner above indicated: *i. e.*, it can be shown that the effect of the contractions is to diminish i and j simultaneously each of them by 0, each of them by 1, or each of them by 2.

Continuing this process of *stripping* the graphs of their outside angles we must come at last to a graph consisting of one line and one column or of only one line, or only one column, or only a point. In the first of these 4 cases i and j are each equal to 2, and in the last 3 each equal to 1, hence $i-j$ is always zero and every U_i corresponds to a V_i. This establishes the very remarkable theorem that was to be proved.

Note on the Graphical Method in Partitions, by J. J. SYLVESTER.

It is well I think to draw attention to the fact that the graphical method introduces two new processes into Arithmetic as elementary and fundamental as those contained in the well known 4 rules—which may be called Transversion and Apocopation.

Transversion is the operation of passing from a partition to its conjugate or transverse, and is identical with that which borrowing from the vernacular of the American Stock Exchange I have elsewhere denominated "*calling.*"

The elements of a partition may be regarded as *Sellers* each holding a certain number of shares in the same stock. On the numbers 1, 2, 3 . . . being successively called out each seller who holds at least that number of shares declares himself, and the number of those so responding each time being set down, a new partition is formed with numbers whose sum is identical with the total number of shares on sale.

The discovery of this process is due to Dr. Ferrers, who informs me that he himself never published it but left it to me to do so in his name in the *London and Edinburgh Philosophical Magazine* for 1853. I may mention that I have never missed an opportunity of expressing my sense of the great importance of the discovery and bringing it under the notice of my pupils, to one of whom, Mr. Durfee (Fellow of this University), is due the discovery (after the lapse of 30 years) which leads to the second process, viz., Apocopation, which institutes a fixed relation between any partition and its transverse.

Apocopation is a process applied to a partition whose parts are arranged in descending order and consists in cutting off from its beginning, all those terms whose magnitude exceeds the number which denotes their place (reckoning from the highest term) in the arrangement. We have then this important theorem—*The numbers of terms subject to apocopation is the same for any partition and its transverse.*

Scaling or *co-summating* a partition consists in adding together each-to-each the apocopated terms in a partition and in its transverse, and diminishing these sums by the several numbers 1, 3, 5 . . . In this way a new partition is formed which may be called the associate-sum of the original partition, so that to every partition there is a transverse and an associate-sum; and the content of each of these three partitions is identical.

The process of *scaling* or co-summation may be indefinitely continued and it is a curious question to determine how often the scaling process must be continued in order for a given partition to be eventually converted into a single term after which of course it remains unaltered by any further application of the process—this problem is naturally suggested by the practice of scaling and rescaling an inconveniently large public debt which is sometimes practiced in the Old World and is not unknown in the New; but the analogy fails in this respect that in the one case the amount of the debt has a tendency to converge to zero, whereas in the other the content of the partition remains constant throughout.

The passage from a partition into odd numbers to the corresponding partition into unequal numbers, is effected by a co-summation operated simultaneously but independently upon two partitions, one of which has for its parts the major-halves and the other the minor-halves of the parts of the given partition.

An Instantaneous Graphical Proof of Euler's Theorem on the Partitions of Pentagonal and Non-pentagonal Numbers, by J. J. SYLVESTER.

[Résumé of a lecture delivered during the current month at the Johns Hopkins University].

I start with the product $(1+ax)(1+ax^2)(1+ax^3)\ldots$; the coefficient of $x^n a^j$ in its development in a series according to powers of x and a is the number of partitions of n into j unequal parts: each such partition may be represented by a regular graph and these graphs classified according to the magnitude of the Durfee-square which they contain. Calling the side of any such square θ, two cases arise, viz. the vertical side of the square may either be completely covered or one point in it be left exposed: in the former case any number of the points in the base of the square, in the latter case not more than the first $\theta - 1$ points can be covered.

The first case contributes to the total number of partitions of n into j unequal parts the number of ways of distributing $n-\theta^2$ between two groups, one consisting of θ unequal parts unlimited, the other of j unequal parts not exceeding θ in magnitude.

The second case contributes the number of ways of distributing $n-\theta^2$ between two groups consisting one of $\theta-1$ unequal parts unlimited, the other of $j-\theta$ unequal parts not exceeding $\theta-1$ in magnitude.

Hence remembering that the number of ways of partitioning any number ν into θ parts is the coefficient of x^ν in

$$\frac{x^{\frac{\theta^2+\theta}{2}}}{1-x\,.\,1-x^2\ldots}$$

it is easily seen to follow that $(1+ax)(1+ax^2)(1+ax^3)$ must be equal to the sum of the two series

$$1+\frac{1+xa}{1-x}x^2\ldots+\frac{(1+xa)(1+x^2a)\ldots(1+x^\theta a)}{1-x\,.\,1-x^2\ldots1-x^\theta}x^{\theta^2+\frac{\theta^2+\theta}{2}}a^\theta+\ldots$$

and

$$xa+\ldots+\frac{1+xa\,.\,1+x^2a\ldots1+x^{\theta-1}a}{1-x\,.\,1-x^2\ldots1-x^{\theta-1}}x^{\theta^2+\frac{\theta^2-\theta}{2}}a^\theta+\ldots;$$

on making $a=-1$ there results

$$(1-x)(1-x^2)(1-x^3)\ldots$$
$$=1-x-x^2\ldots+(-)^\theta\left(x^{\frac{3\theta^2-\theta}{2}}+x^{\frac{3\theta^2+\theta}{2}}\right)+\ldots$$

which is the theorem to be proved.

In the Appendix or Exodion to a forthcoming paper in the *American Journal of Mathematics* I give a proof by the method of correspondence of Jacobi's generalization of the above theorem, viz.:

$$(1\pm x^{n-m})(1\pm x^{n+m})(1-x^{2n})(1\pm x^{3n-m})(1\pm x^{3n+m})(1-x^{4n})\ldots$$
$$=\sum_{-\infty}^{+\infty}(\mp)^i x^{ni^2+mi}.$$

On Properties of Conics in Non-Euclidean Geometry, by W. E. STORY.

[Abstract of a paper read at the meeting of the University Mathematical Society, February 21, 1883].

This communication contains an application to conics of the "projective" measurement invented by Cayley, generalized by Klein, and still farther extended by the writer in a paper "On the Non-Euclidean Geometry," (*Am. Jour. Math.*, *Vol. V*). An arbitrary conic Ω is taken for the absolute, and for convenience each of the constants k in the paper just mentioned is taken to be $\frac{1}{2i}$.

With respect to the absolute the conic S has certain peculiar points and lines, viz.:

3 *centres*, vertices of the self-conjugate triangle common to S and Ω;
3 *axes*, sides of the self-conjugate triangle common to S and Ω;
4 *absolute points*, points common to S and Ω;
4 *absolute tangents*, tangents common to S and Ω;
4 *asymptotes*, tangents to S at absolute points;
4 *asymptotic points*, contacts with S of absolute tangents;

6 *foci*, intersections of absolute tangents 2 and 2, which can be grouped in a definite way into 3 pairs, the foci of each pair being on the same axis;

6 *absolute chords*, junctions of absolute points 2 and 2, also polars of foci *quâ S*, which can be grouped in a definite way into 3 pairs, the chords of each pair passing through the same centre;

6 *directrices*, polars of foci *quâ S*, also junctions of asymptotic points, grouped in a definite way into 3 pairs, corresponding to the 3 pairs of foci, the directrices of each pair passing through the same centre;

6 *directors*, poles of absolute chords *quâ S*, also intersections of asymptotes, grouped in a definite way into 3 pairs, corresponding to the 3 pairs of absolute chords, the directors of each pair lying on the same axis.

The following theorems are easily proved:

The 3 axes as well as the 3 centres of S are mutually perpendicular; the intersections of S with any straight line through a centre are at equal distances from the centre and on opposite sides of it; the tangents to S from any point of an axis are at equal distance from the axis and on opposite sides of it; if ρ_1 and ρ_2 are the distances of any point of S from any two (fixed) centres of S, respectively, there is a relation of the form

$$A\sin^2\rho_1+B\sin^2\rho_2+C=0,$$

where A, B, C are constants; similarly if α_1 and α_2 are the angles which any tangent of S makes with any two (fixed) axes of S, respectively, there is a relation of the form

$$A'\sin^2\alpha_1+B'\sin^2\alpha_2+C'=0,$$

where A', B', C' are constants; if r_1, r_2 are respectively the distances of any point of S from the two foci of the same (fixed) pair, there is a relation of the form $r_1\pm r_2=2a$, or more properly $(r_1\pm r_2)^2=4a^2$, where $2a$ is the distance between the intersections of S with the axis through the two foci in question, and the two signs $\pm$ refer to different conics; similarly if τ_1, τ_2 are respectively the angles which any tangent to S make with the two absolute chords of the same (fixed) pair, there is a relation of the form $(\tau_1\pm\tau_2)=2a$, or more properly $(\tau_1\pm\tau_2)^2=4a^2$, where $2a$ is the angle between the tangents to S from the centre through which the two absolute chords pass, and the two signs $\pm$ refer to different conics; if r, p are respectively the distances of any point of S from a focus and the corresponding directrix, there is a relation $\frac{\sin r}{\sin p}=\text{const.}$; similarly if τ, q are respectively the distances of any tangent of S from an absolute chord and the corresponding director, there is a relation $\frac{\sin\tau}{\sin q}=\text{const.}$;

the 2 radii to a point of S from the foci of any one pair make equal angles, on opposite sides, with the tangent at the point; the 2 intersections of a tangent of S with the absolute chords of any one pair are equally distant, on opposite sides, from the contact of the tangent.

A circle is a conic S having double contact with the absolute; it has one isolated centre C, and a line of centres (the common polar of C *quâ* Ω and S); the distance of any point of S from C is constant; not so with the distance of any point of S from a centre of the line; the 2 tangents to S from any point in the plane are of equal lengths; the circle has one isolated axis (the line of centres) and a pencil of axes through the isolated centre; the distance of any tangent of S from the isolated axis is constant; not so with the distance of any tangent from an axis of the pencil; the tangents to S at its 2 intersections with any line in the plane make equal angles with the line; any tangent to S is perpendicular to the radius to its point of contact from the isolated centre; any point of S is perpendicular to the intersection of the tangent at that point with the isolated axis.

Two circles are relatively *orthogonal* if their tangents at an intersection are mutually perpendicular, say they have an orthogonal intersection; 2 circles are relatively *orthometric* if their contacts with a common tangent are mutually perpendicular; say they have an orthometric common tangent; then two relatively orthogonal circles have 2 and only 2 orthogonal intersections, and 2 orthometric circles have 2 and only 2 orthometric common tangents.

Two circles have 2 *radical axes*, those common chords which intersect in the intersection of their isolated axes; the 4 tangents to 2 circles from any point of either of their radical axes are of equal lengths; the 6 radical axes of 3 circles meet by 3's in 4 points, the *orthogonal centres* of the 3 circles; these are the isolated centres of the 4 *orthogonal circles* of the 3 given circles; similarly 2 circles have 2 *radical centres*, those intersections of common tangents which lie on the junction of their isolated centres; the angles which any line through either radical centre makes with the tangents to the circles at its 4 intersections with them are equal; the 6 radical centres of 3 circles lie by 3's on 4 straight lines, the *orthometric axes* of the 3 given circles; these are the isolated axes of the 4 *orthometric circles* of the 3 given circles.

On Partitions, by F. Franklin.

[Abstract of a paper read at the meeting of the University Mathematical Society, February 21, 1883].

Denoting by $(w : i, j)$ the number of ways in which w can be composed of i or fewer parts none greater than j, $(w : i, j)$ is the coefficient of $a^j x^w$ in the development of

$$\frac{1}{(1-a)(1-ax)(1-ax^2)\dots(1-ax^i)},$$

so that the generating function in which the coefficient of x^w is $(w : i, j)$ is the coefficient of a^j in the development of the above fraction in ascending powers of a. To obtain this generating function directly, we observe that the number of ways of forming w with i or fewer parts of which one at least is a number greater than j, say $j+k$, is equal to the number of ways of forming $w-(j+k)$ with $i-1$ or fewer parts; that the number of partitions in which two at least of the parts are numbers greater than j, say $j+k, j+k'$, is equal to the number of partitions of $w-(j+k)-(j'+k')$ into $i-2$ parts, and so on; hence the G. F. required is

$$\frac{1}{(1-x)(1-x^2)\dots(1-x^i)} - \frac{x^{j+1}+x^{j+2}+\dots}{(1-x)(1-x^2)\dots(1-x^{i-1})}$$
$$+\frac{x^{j+1}(x^{j+2}+x^{j+3}+\dots)+x^{j+2}(x^{j+3}+\dots)+\dots}{(1-x)(1-x^2)\dots(1-x^{i-2})}$$
$$-\frac{x^{j+1}x^{j+2}(x^{j+3}+\dots)+x^{j+2}x^{j+3}(x^{j+4}+\dots)+\dots}{(1-x)(1-x^2)\dots(1-x^{i-3})}+\dots$$
$$=\frac{1}{(1-x)(1-x^2)\dots(1-x^i)}\left\{1-x^{j+1}\frac{1-x^i}{1-x}\right.$$
$$\left.+x^{j+1}x^{j+2}\frac{(1-x^{i-1})(1-x^i)}{(1-x)(1-x^2)}-\dots+x^{j+1}x^{j+2}\dots x^{j+1}\right\}.$$

The expression last written is a finite form of the generating function; but returning to the first expression, we may write it in the form

$$\frac{1}{(1-x)(1-x^2)\dots(1-x^i)}\left\{1-(1-x^i)\Sigma_1(x^{j+1}, x^{j+2}, \dots)\right.$$
$$\left.+(1-x^{i-1})(1-x^i)\Sigma_2(x^{j+1}, x^{j+2}, \dots)-\dots\right\},$$

where $\Sigma_m(x^{j+1}, x^{j+2}, \dots)$ means the sum of the m-ary combinations of the quantities $x^{j+1}, x^{j+2}, x^{j+3} \dots$ *ad inf.*; and it is easy to prove by induction that

$$(1-x^i)(1-x^{i-1})\dots(1-x^{i-m+1})\Sigma_m(x^{j+1}, x^{j+2}, x^{j+3}\dots)$$
$$=\Sigma_m(x^{j+1}, x^{j+2}, \dots x^{j+i}).$$

Hence the above generating function is equal to

$$\frac{(1-x^{j+1})(1-x^{j+2})\dots(1-x^{j+i})}{(1-x)(1-x^2)\dots(1-x^i)}.$$

But the method by which the equation last written is inductively proved suggests a more direct mode of obtaining the generating function by means of the correspondence in the partitions themselves; this method will be found incorporated in Prof. Sylvester's memoir on Partitions in the forthcoming number of the *American Journal of Mathematics.*

[*Addendum.* The theorem, due to Euler, that a number can be formed in as many ways with odd numbers, repetitions being allowed, as with general numbers unrepeated may be proved constructively and extended as follows: the number of ways of forming w with an indefinite number of parts not divisible by k and with m distinct parts (each indefinitely repeated) divisible by k is equal to the number of ways of forming w with an indefinite number of parts each occurring less than k times and with m distinct parts each occurring k or more times. To prove the generalized theorem when m is zero, we may suppose, to fix the ideas, that $k=10$, the reasoning being perfectly general. Consider any partition consisting only of parts not divisible by 10, let the number of times any such part λ occurs be written in the decimal notation $\dots cba$; then if in place of $\dots cba$ times λ we write a times λ, b times 10λ, c times $100\lambda, \dots$ we get a partition in which no part occurs as many as ten times; and we have evidently a 1 to 1 correspondence. Thus the theorem is proved when $m=0$. If now along with the non-tenfold parts we introduce m distinct parts each of which is divisible by 10, and at the same time introduce in the corresponding partition of the other set ten times these same parts each divided by 10, the partitions of the second set will contain m parts occurring 10 or more times, while the 1 to 1 correspondence will not be disturbed. This proves the theorem].

On the Tabulation of Symmetric Functions, by W. P. Durfee.

[Abstract of a paper read at the meeting of the University Mathematical Society, February 21, 1883].

At a former meeting of the Society, I gave an outline of a method of arranging the partitions of a given number so that the table of symmetric functions of that weight should be symmetrical and at the same time be confined to a half square with the exception of certain coefficients which belonged to the lines and the columns of the self-conjugates. While the method there given was somewhat imperfect I find that there is a definite arrangement which effects the desired end. It may be stated as follows: Write the partitions in groups beginning with the group containing those of one part, then that containing those of two parts and so on, arranging the partitions of each group in natural or dictionary order, and omitting all partitions whose conjugates have been written earlier and all self-conjugates. This will include one-half of all the partitions less the self-conjugates. Write next the self-conjugates in any order and finally write the conjugates of the first part in inverse order. If the partitions at the head and side of the table be written in this order the table will have the desired form.

A paper containing the principles upon which the foregoing is founded, will appear in a future number of the *American Journal of Mathematics.*

[Scientific Notes Continued].

NOTES IN BIOLOGY.

On the Influence of Quinine on the Rate of Flow through the Blood-Vessels, by H. H. DONALDSON *and* L. T. STEVENS.

[Note from the Biological Laboratory, April 6, 1883].

Thus far experiments have been made on the "slider" terrapin only. To determine the influence of the drug on the rate of flow through the vessels, independent of any effect which might be produced on the heart by the action of the drug, a method was used which may be described as follows:

A large opening being made in the plastron over the region of the heart, the pulmonary arteries were ligatured, the heart cut away, and cannulas placed in the left aorta and innominate trunk and also in the three great veins. The arterial cannulas were then connected with feeding flasks filled with normal salt solution and this was allowed to flow into the vessels under a known pressure. Having traversed the arterial system the fluid returned by the veins and was collected and measured as it flowed out. The resistance offered to the liquid under these conditions is of course that of the small arteries and capillaries and any variation in the size of these vessels must be followed by a variation in the amount of liquid which flows out: a narrowing of the vessels causing increased resistance and a decrease in the quantity of liquid which passes through in a unit of time, and a widening causing a decreased resistance and an increase in the quantity of liquid. We have made experiments on terrapin with the central nervous system intact and also with the same destroyed. In the former case the animal was curarized. In both cases there is a much increased flow through the blood vessels after quinine. In many cases it was possible to recover the vessels back to their previous state of distension and then giving quinine to again get an increase in the amount of the flow through them. As this variation occurs after the destruction of the central nervous system the drug must act on some peripheral mechanism. It is not yet clear whether it acts on the muscular coats of the small arteries or on the capillaries or on both. These effects are obtainable with a solution of quinine equal to .002 grms in 100 c. c. of salt solution or 1 part in 50000. We have evidence then for the view that, in the terrapin, quinine dilates the small blood vessels and can act without the aid of the central nervous system. Further experiments will be made on frogs.

On the Origin of Alternation of Generations in Hydro-Medusae, by W. K. BROOKS.

[Abstract of a paper read at the meeting of the University Scientific Association, April 4, 1883].

It is hardly possible that the form of development which we now find in most of the hydro-medusae can bear any close resemblance to their primitive life history: and there are many reasons for believing that alternation of generations has gradually arisen through the modification of "metamorphosis."

In *Cunina* we seem to have the ancestral form of development: a direct metamorphosis, without alternation. The interesting and remarkable life history of *Cunina* was first described by Prof. John McCrady, who found inside the bell of a hydro-medusae, *Turritopsis*, at Charleston, S. C., a number of hydra-like larvae attached by short tentacles to the sub-umbrella, and furnished with a very long and flexible proboscis, with the oval opening at its tip. These larvae are parasitic and they obtain their food by inserting the proboscis into the mouth of the *Turritopsis*, and thus sucking from its stomach the food which it contains. In his first paper upon the subject, Prof. McCrady stated his belief that these larvae were the young of the *Turritopsis* which carries its young inside its umbrella and nourishes them with partially digested food from its own stomach. Although McCrady soon corrected this error and showed that they are not the young of *Turritopsis*, but the larvae of *Cunina*, Romanes, in his recent work on Animal Intelligence, has quoted McCrady's error without his correction, and refers to this instance of parasitism, as a case of maternal care for the young among the Coelenterata.

During the past summer both *Turritopsis* and *Cunina* were extremely abundant at Beaufort, N. C., throughout July and August, and I was fortunately able to trace the life history of each of them.

The larva of *Cunina* is a hydra, with the power of asexual multiplication: but instead of giving rise to medusa buds, like an ordinary hydroid, it becomes directly converted into a medusa, by a process of metamorphosis; it is a true larva aud not an asexual generation, although the occurrence of asexual reproduction renders the gap between this form of development and true alternation very slight indeed.

In *Cunina* we have a series of this kind:

```
Egg,
 |
Larva — Larva — Larva,
 |        |        |
Adult    Adult    Adult.
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If the larva which is produced from the egg were to remain permanently in the hydra stage we should have a series like this:

```
Egg,
 |
Hydra — Hydra — Hydra,
          |        |
        Medusa   Medusa,
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and such a history would be a true alternation.

On Radial and Bilateral Symmetry in Animals, by H. W. CONN.

[Abstract of a paper read at the meeting of the University Scientific Association, March 7, 1883].

The relation of radial to bilateral symmetry among animals is a question in regard to which there has been considerable discussion. It is however to-day pretty generally acknowledged that the type of radial symmetry must have preceded that of bilateral symmetry. Two important views are current as to the origin of a bilateral form of symmetry, such as is presented by the group Vermes, from a radial symmetry such as we find in the Coelenterata. The simplest view, of which Ray Lankester is an exponent, is as follows:

Starting with a radially symmetrical larva, this view supposes that the two forms of symmetry arose with reference to the stationary or locomotive life of the animal. On the one hand, the stationary animal retains its primitive radial symmetry and grows into a radiate adult. On the other hand the locomotive larva is modified by its free life. Its growth, in order to give greater freedom of motion, results in an elongation of the body in a direction parallel with its axis. Such a long cylindrical body would of necessity soon develop swimming organs; and these swimming organs in order to give greater steadiness of motion and prevent an inconvenient revolution of the body, would appear in such a position as to give the animal an upper and an under surface, and consequently a bilateral symmetry. With the continued elongation of the body, the digestive tract, which at first ended blindly, also would elongate and finally acquire a posterior opening at a position directly opposite the mouth. This view, then, supposes the body of the radiate animal to elongate in the direction of its long axis, and a bilateral symmetry to arise in reference to the organs of locomotion.

A second view, advanced by Balfour, while based on the same fundamental principle of stationary and free life, supposes the change to take place in a different fashion. This view supposes that the growth of the free living radiate form resulted in an elongation not in the direction of the axis of the animal, but rather at right angles to this axis. This places the mouth of the animal, from the first, not at one extremity but upon one side, which therefore becomes very early the ventral side. The swimming organs afterward arose in reference to the already indicated bilateral symmetry.

These two views are fundamentally different. Besides affecting our belief as to the manner in which bilateral symmetry arose, the acceptance of one or the other is the foundation of our understanding of the homologies which are to be found in the two groups.

Evidence for the one or the other of the views is to be looked for in embryology, but very few animals give an opportunity for such research owing to secondary changes which have acted upon the ova and the embryos. For this reason no direct evidence has been hitherto obtained. At Beaufort during the last summer some work was done upon Thalassema, a species of worm which possesses a very primitive development and enables a direct study of the origin of bilateral symmetry from radial symmetry to be made. The results of the observations were satisfactory upon the point in question, and showed that as far as this group of animals is concerned, the second of the above views, viz.: that of Balfour, is in all essential respects correct. The radially symmetrical gastrula elongates nearly at right angles to its long axis, and gives rise to a bilateral larva, of which the ventral surface has been from the first indicated by the position of the mouth. The acquisition of a direct motion occurs sometime after the animal is truly bilateral, an indirect revolutionary motion being gradually changed into a direct motion with its anterior extremity in advance.

List of a few Additions to the Species of Birds, Reptiles and Batrachians Mentioned in Dr. Elliott Coues' Paper on the "Natural History of Fort Macon and Vicinity," by H. GARMAN.

[The species mentioned below were observed at Beaufort in 1881 while studying at the Johns Hopkins Marine Laboratory].

Sialia sialis.—September.
Parus carolinensis.—September
Muiotilta varia.—September.
Sophophaues bicolor.—September.
Sitta pusilla.—September.

Deudrœca æstiva.—This bird was noticed at Beaufort in September feeding on the fruit of a "mulberry tree." This is the second instance which has come under my observation of a warbler attacking fruit. *Helminthophaga peregrina* seriously injures the grapes in North Illinois by puncturing them and sipping the juice.

Dendrœca pinus.—September.
Setophaga ruticilla.—September.
Picus pubescens.—September.
Nanemys guttatus.
Chelydra serpentina.
Siurus nævius. August 14.
Trochilus colubris.—July. (Abundant).
Cistudo clausa.—Probably the Cistudo refered to by Dr. Coues.
Cinosternum pennsylvanicum.—(Abundant).
Enmeces fasciatus.

Anolis principalis.—Beaufort is probably near the northern limit for this species. Holbrook says it does not occur north of the 34th parallel of latitude. It was abundant about rail fences which were partially overgrown by herbage. Under the influence of fright, or at will, the color may change from a bright green to dull olive brown or the reverse. When the green color predominates a slight pinch with a pair of blunt forceps causes a brown spot to appear at the point compressed. During the summer of 1882, they were seen in the interior of North Carolina running about on the leaves of trees and springing from branch to branch in pursuit of insects.

Bufo quercicus.—A single pale specimen of this peculiar toad was collected at Beaufort. From an examination of the stomachs of several specimens of this species taken at different dates and localities in North Carolina, I find that it feeds exclusively on ants. The note resembles that of a young plover. Specimens do not vary much from an inch in length from the snout to the tip of the urostyle. Apparently breeding near Wilmington, July 20, 1882.

Note on the Anatomy of the Malar Bone, by E. M. HARTWELL.

[Abstract of a paper read at the meeting of the University Scientific Association, March 7, 1883].

Attention was called to the proposal of Dr. F. W. Langdon, of Cincinnati, in a paper on the Madisonville Prehistoric Cemetery, (published in the Journal of the Cincinnati Society of Natural History, October, 1881,) to apply the name of "temporal process" to "a spine-like and occasionally unciform process," found to occur on the posterior upper border of the malar bone in a large number of the human crania exhumed at Madisonville, Ohio. It was shown that the term "*Processus temporalis*" was applied to the posterior lower process of the malar bone as early as 1794, by Loder; that, while in the standard English manuals of anatomy, with the exception of the ninth edition of Quain, this lower process is termed zygomatic, the best German anatomists have long followed the nomenclature of Loder. It was further shown that the process proposed to be called "temporal" by Dr. Langdon, was named *Processus marginalis* by Prof. H. Von Lushcka, of Tübingen, in 1867, which name has been adopted by Henle; that Broca termed it "*Epine jugale*" or jugal spine; that G. J. Schultz, of St. Petersburg, called attention to the same process in 1852, without giving it a special name; and that Vesalius in the first edition of his "*De Humani Corporis Fabrica,*" published in 1543, distinctly figured and specially marked the marginal process of Luschka. It was suggested that the marginal process of the malar bone possessed less anthropological significance than had been supposed, inasmuch as the writer had determined its occurrence in skulls of all the principal races of men represented in the Morton Collection of Crania, in Philadelphia.

[Scientific Notes Continued].

NOTES IN CHEMISTRY AND PHYSICS.

On the Action of Phosphorus on Moist Air and Carbon Monoxide, by IRA REMSEN.

[Abstract of a paper read at the meeting of the University Scientific Association, February 7, 1883].

The speaker gave an account of experiments which he has been engaged upon for some time past with the assistance of Mr. E. H. Keiser. The object was to determine whether phosphorus and moist air have the power to oxidize carbon monoxide. Leeds and Baumann agree that the carbon monoxide is oxidized. In the light of some results recently obtained in this laboratory the conclusion of the above named chemists seemed improbable and hence their experiments were repeated. After a large amount of labor had been spent in the investigation, an apparatus was finally devised in which all joints were protected with either water or mercury, so that the ozone formed by the action of the phosphorus in the air could not come in contact with organic substances like cork or rubber in its passage through the apparatus. It was only when this precaution was taken that the gases drawn through the apparatus failed to produce a precipitate of barium carbonate in baryta water. The effect was exactly the same whether carbon monoxide was mixed with the air or not. The experiment was repeated a number of times, and always with the same result. There can hence be no doubt that the conclusion of Leeds and of Baumann is incorrect. Carbon monoxide is not oxidized by air in the presence of moist phosphorus.

Leed's error is easily accounted for. He passed the ozonized air from the flask containing the phosphorus through a tube containing cotton for the purpose of removing oxides of phosphorus. Now, ozone acts upon the oily substances which adhere to cotton and oxidizes them, forming carbon dioxide, and it was this that was collected and supposed to be formed by the oxidation of carbon monoxide. Special experiments were performed to prove the correctness of this supposition.

From the above it is clear that the experiment of Leeds and Baumann furnishes no evidence in favor of the view that there is an active form of oxygen distinct from ozone.

On the Helmholtz-Koenig Controversy, by G. BISSING.

[Abstract of a paper read at the meeting of the University Scientific Association, February 7, 1883].

In view of certain objections to Koenig's method [*Journal de Physique, December*, 1882], an attempt was made to determine by direct experiment the influence of the phase of the overtones on the timbre of a sound. Tuning-forks supplied with electro-magnets and resonators were used, and the difference of phase was obtained either by altering the lengths of the tubes which conducted the sound from the resonators to the ear or by putting the driving-forks slightly out of tune. But in neither case could the slightest influence of the phase on the timbre be detected.

COMMUNICATIONS TO THE HISTORICAL AND POLITICAL SCIENCE ASSOCIATION.

The Genesis of a New England State, by ALEXANDER JOHNSTON.

[Abstract of a paper read before the Historical and Political Science Association, April 13, 1883].

The present State of Connecticut, in its formation, is an instructive example of the manner in which the town system can, if it has free scope, build up the frame of a commonwealth. In most of our other original States, limits were imposed upon the colony, the future State, directly or indirectly, by the King; and the same is true of the newer States, substituting Congress for the King. Thus the town system, on its first appearance, found itself the tenant of a shell which had already been provided for it by another power. The general rule, then, is that the limits, the body, of a town have their origin in the will of the commonwealth, while its spirit is from the Germanic heredity of its inhabitants; and the limits, the body, of the commonwealth have their origin in the will of the King or of Congress, while its spirit is that of the town system or its equivalents.

But in Connecticut, from a variety of reasons, the rule did not hold. The territory which makes it up was a No-Man's-land, granted in effect to no one; there was no power to impose limits upon it; and no commonwealth power to impose limits upon the towns. Into this No-Man's-land, in 1634-6, three organized Massashusetts towns, Dorchester, Watertown, and Newtown, moved almost bodily. They retained their Massachusetts town names, magistrates, civil and ecclesiastical organization, and town feeling; and they left behind them the superintending Massachusetts commonwealth. It was the Massachusetts town system set loose in the perfect freedom of the wilderness.

The result showed the power of the system to make its own commonwealth. The three towns agreed on their respective limits. Deputies, or committees, from the towns united with the magistrates to form a General Court. All the machinery of a commonwealth was evolved naturally and simply. And in 1639, the towns framed the first American written constitution, which really endured until 1818, since the charter of 1662 was in reality only a confirmation of it.

To the three original towns, the new towns, as they were formed, at first joined themselves by a process of natural accretion. There were some vague claims of the new commonwealth to a supremacy in the vacant territory, but they were founded mainly on Indian conquest, and were either not pressed or touched upon very delicately, as a dangerous subject. The consequence was that the Connecticut towns were left almost absolutely free. But in the southern part of the territory, another colony had been planted at New Haven. It also attempted to extend its limits. It did so by direct purchase exclusively, and, feeling that it had a property right in the new towns, it restricted their local self government as Connecticut had never ventured to do. For nearly twenty years the struggle continued between the free town system of Connecticut and the shackled town system of New Haven, to the manifest advantage of the former. Finally, in 1662, Connecticut precipitated the inevitable catastrophe by obtaining from the new King a charter including the New Haven territory.

The existence of the Commonwealth of Connecticut, however, was not due to the charter. Connecticut was as truly a self governing State in 1639 as in 1776, and the authority of the King was only brought in to obviate the necessity of an open struggle with the colony of New Haven, whose independent existence marred the natural outline of the State. But the rights of local self government, which made Connecticut the most democratic of the colonies, were altogether antecedent to the charter; they were won by the towns, not granted by the King. And before the charter was granted, the new town-commonwealth had pushed back the asserted boundaries of Massachusetts on the north, New Netherlands on the west, and Massachusetts or Rhode Island on the east to very nearly their present position. From the first migration of the three towns, there was no mention of any source of authority, except the people of the towns, and on this basis the commonwealth was built. Its spirit was not different from that of other colonies; but its body, the outline of its tenement, was not due to the will of King, Kaiser, or Congress, but to the will and spirit of the towns.

The English Parish in America, by H. B. ADAMS.

[Abstract of a communication to the Historical and Political Science Association, January 26, 1883, preliminary to a lecture before the Peabody Institute, February 1, 1883].

Mr. Edward A. Freeman, in one of his notes to "The Growth of the English Constitution," says "The real history of English parishes has yet to be worked out. I feel sure that they will be found to have much more in common with the continental Gemeinden than would seem at first sight. Some hints may be found in a little pamphlet which I lately came across, called *The Parish in History*." One of the minor results of Mr. Freeman's visit to Baltimore was the discovery by Mr. Adams of the authorship and only mode of obtaining this rare tract, which London book-sellers had despaired of procuring. In this pamphlet and in other writings sent to Baltimore by the author, James Hicks Smith, only two weeks before his death (December 28, 1882), were found valuable suggestions touching the origin of the English Parish.

This institution had its beginning in the adaptation of the Christian *παροικία* (best described by Hatch in the Bampton Lectures of 1880), to the Germanic Village Community, which was flourishing in England before the Roman missionaries came. Pagan townships, with their local names and superstitions, became Christian Parishes wherein much that was old survived in popular ways. The Parish of Thorington is after all but the Town of Thor and his Christian descendants. Wednesbury (the Borough of Wodan) was converted into the ecclesiastical district of a priest representing a new deity. But old forms of local life and of popular assembly everywhere lingered on and constituted the physical basis of the English Parish, as truly as the municipal constitution of the old classic world lies at the root of episcopalian, presbyterian, and all other forms of church government. The local *folcmote*, or the town meeting, of pagan England became the parish meeting, which, before vestries were heard of, met in the nave of the Church, itself an architectural link between modern Town Halls and classic Basilicas or forums of justice.

Attention was called to the continuity in America of these old forms of popular assembly in the Parish meetings of New England, which still assemble in the Parish Church of the smaller Towns, although often in so-called "Vestries," small out buildings near or adjoining the Church. Such assemblies endure everywhere at the South in the Vestry Meetings of Parishes, whose Select Vestrymen, often seven in number, are only the ecclesiastical parallel of New England Selectmen, "the Seven Men" as they were once called. The manuscript records of St. John's Parish, in Maryland, were quoted at length for the purpose of illustrating the temporal proceedings of a typical English Vestry in America. The management of the Parish Glebe (divided into various farms leased to tenants) corresponds in agrarian interest to the administration of the Common Lands of a New England Town. The Glebe of St. John's, which was sold in 1818, originated in the bequest of "Stoakly Manor" of 550 acres, in 1675, for the support of the parish incumbent. Almost every Maryland Parish once had its glebe land, reserved by authority or presented by patrons. Many similar instances could be cited of the territorial endowment of Church and School in New England, for example the glebe land in Portsmouth, N. H., and the School Meadows in Hadley, Massachusetts. The Old English Parish idea is perpetuated in New England within the limits of Towns, whereas, at the South, Towns and Villages almost everywhere sprang up within the larger territory of Parishes. Both facts have their prototypes in the municipal history of Old England, where in many cases townships occur within parishes and where often parishes and wards make up a comprehensive town, although in many instances the bounds of town and parish are coincident, as was everywhere the original fact in New England.

Villes and Plantations, by H. B. Adams.

[Notes on a lecture delivered before the Peabody Institute January 30, 1883, and abridged for the Historical and Political Science Association, April 6, 1883].

Villes.—In the names of places throughout the older states, particularly at the South, the suffix *ville* is of such frequent occurrence as to be noticeable in gazetteers and upon county maps; but in popular speech, in designating small neighborhoods or hamlets, this suffix, used in connection with the name of some prominent family or with some dominant local interest, is even more common than in its printed forms. New England towns and Southern counties are full of small localities, too small for official recognition as post offices or as incorporated villages, and yet large enough to have local habitations and a name.

Attention is called to the fact that these numerous *villes*, in their hamlet-form, represent historically the minutest germs of state-life. They are not only the institutional seed from which spring larger communities, but they are the survival in name and fact of one of the oldest types of local life known to English history. The *ville* is not a corruption of the Romance *villa*, but a pure survival of the Germanic *Weiler*, or hamlet, which in Normandy was everywhere established by Teutonic influences, just as it was everywhere planted throughout the Rhine country in the *Heims* and *Weilers*, known to student-pedestrians. In England, as in Germany and Normandy, the *ville* has the historical character of a patriarchal hamlet or of a neighborhood of families. In the early statutes of England and in the older writers on English institutions, the word is often spelled "vill." Blackstone says, "Tithings, towns, or vills are of the same signification in law." The vill became an organic part of the state, a recognized civic unit, just so soon as it had a Constable or a Tithingman, who converted the place into a Ward and kept the local peace by legal authority.

Plantations.—It is an interesting fact that the first settlements in this country, both in the North and at the South, were everywhere called Plantations with precisely the same original significance in both sections of country. The word was a common one in English colonial usage and was applied to land occupied for cultivation, without regard to the kind of crop, whether English grain, Indian corn, tobacco, sugar, or rice. Plantations were of two sorts, individual and collective; the first sort was a mere farm; the second, a group of farms, often thus designated, as for example, "Cambridge Farms." In New England, the collective use of the old word survives in "Providence Plantations" and in the well-known Plantations of Maine. The settlements at the South were often collective or communal like Henrico Plantation and the New Bermudas, both of which were palisaded and consisted of a group of houses and farms. The original collective character of the Virginia Plantations is indicated in a somewhat striking way by the Act of 1624 (see Hening, i, 128) whereby "the inhabitants of every corporation shall fall upon their adjoyning salvages." In the South as well as at the North there were, from the outset, numerous private Plantations and, in the South, this type ultimately prevailed by reason of various economic and social causes, for example, the extent of land, the fertility of the soil, the nature of the crops, the influence of climate, the introduction of indented servants and slaves, together with the triumph of aristocratic ideas or of a country gentry, representing the rural order of civilization.

It is noteworthy that upon every private plantation there survived a kind of village-life in the so-called "Quarters," where, under the absolute authority of the master, a negro community was made to reproduce somewhat the same condition of things as existed in a community of serfs upon the manor of a feudal lord. The Negro "Quarters" consisted of rows of cabins or cottages, built along the line of a common street and separated from one another by fences and garden-"patches," within which limits the slaves were allowed to raise produce, pigs, and poultry of their own, precisely as did the mediaeval serfs. Moreover the slaves regarded some portions at least of their master's Plantation as did serfs their lord's waste land, namely as common for fuel and pasture. The swine of the negro-village were allowed to run at large in the master's woods, each one of the common herd bearing his negro-owner's mark, according to the custom of simple agricultural communities. Frederick Law Olmsted, whose writings are among the best sources of Southern economic history, says, "It is told me as a singular fact that everywhere on the plantations, the agrarian notion has become a fixed point of the negro system of ethics: the result of labor belongs of right to the laborer, and on this ground, even the religious feel justified in using massa's property for their own temporal benefits."

One of the most remarkable descriptions by Mr. Olmsted is of a rice Plantation in Georgia, where an enterprising slave-owner of Northern birth reproduced among his negroes the thrifty village-life and the neat tenement-houses of New England. He even instituted a village-green or town common, two hundred feet wide. It was no uncommon thing upon Southern Plantations for the more practical arts and trades to be successfully carried on by negro slaves, who made excellent carpenters, blacksmiths, and mechanics, and who dealt in small wares in a thriving way. Not only was the economy of an English village reproduced under the direction of white men upon the Southern Plantations, but even the parish-life of white masters was roughly copied by their slaves who had churches and chapels, parsons, and congregations, that united families in a larger local life than could a single negro-village.

The local government of Plantations was personal and more or less paternal. In some states the law required the owner of ten slaves to employ an overseer. This office probably had its origin in the old English household custom of supervising the work of servants and apprentices, who were held to a strict account of themselves by family-overseers and local tithingmen (the latter overseeing a neighborhood-group of at least ten families). We see the outcroppings of these old English customs in the instructions of the Massachusetts Company in 1629, "to the Governor and Council for London's Plantation," at Salem. They were to "appoint a carefull and dilligent overseer to each familie, who is to see each person employed in the business . . . appointed for . . . The said overseers . . . are to keepe a perfect register of the dayly worke done by each person in each familie" (Records of Mass. i, 400-1). In the Plymouth Plantations there were appointed white "overseers," of the Indians, who lived in scattered villages and were held strictly to right in groups of ten under the direction of Indian Tithingmen and Indian Constables, who apprehended every "runaway" Indian servant and brought him before the nearest Overseer "to be whipt and sent home to his or her master." Negro "Drivers" performed similar offices for the Overseers of Southern Plantations, where the Old English constabulary system survived in the so-called "Patrol." The system of written "passes" for negroes going to and fro between Plantations at the South was in vogue in Plymouth Colony, where no Indian was permitted to go from one Plantation to another without a "pass" from his "Overseer," stating where he was going, for what reason, and how long he could stay. If found without a pass, a strolling Indian could be arrested, fined, "or be whipt and sent home to his owne place." This custom of Plantation "passes" had its origin in the parish laws of old England against vagabonds and was introduced into the parish life of the South.

The Township in Maryland, by L. W. Wilhelm.

[Abstract of a paper read before the Historical and Political Science Association, January 29, 1883].

One of the most important and interesting territorial divisions of the early English tribes was the township. According to Canon Stubbs it may have represented the allotment originally granted settlers, or the settlement of kindred, or the estate of a great proprietor. The inhabitants of the township were allowed to make local laws for their own government and to be represented in the more important assemblies of the hundred court and shire court. The erection of manors disturbed the autonomy of the township, so that the latter were not allowed to legislate upon matters of manorial jurisdiction.

The prevalence of manors in colonial Maryland prevented the development of the township system. The history of the territorial divisions of Maryland is as yet unwritten. It is, however, very probable that the township never existed as a distinct organization. The so-called Nottingham Township mentioned in some statutes in Kilty's Laws of Maryland is well described in Johnson's History of Cecil County. Nottingham lay in the extreme northern part of the county, containing about 18,000 acres. It had formerly been a part of Chester County, Pennsylvania, but was ceded to Maryland about the year 1732.

Some villages of Maryland were made the popular center of the surrounding country in a manner somewhat analogous to the villages of the

New England towns. By an Act of 1812, ch. 72, the village of Snow Hill, Worcester County, was constituted. The ten commissioners chosen were to live within the village or within a radius of three miles. They were authorized to call town-meetings of voters upon "extraordinary occasions."

The occurrence of the word "townland" in the earlier statutes of Maryland indicates the possible influence of Irish polity upon the colonial legislation. As Calvert's manor of Baltimore, in Longford County, was situated almost in the heart of Ireland, he must have recognized and profited by Irish territorial subdivisions. These were the barony or hundred, the parish, the townland, and the manor. An Irish historian alludes to the "townlands" as "the ancient and recognized divisions of the country." They were the smallest territorial subdivisions. It is somewhat curious that although "the natives of Ireland never performed so good a work as to build a city," yet from time immemorial they possessed townlands. Many of the towns of Maryland laid out by Act of 1683 were ordered to be erected upon existing townlands.

The Baltimore and Ohio Employés Relief Association, by B. J. Ramage.

[Abstract of a paper read before the Historical and Political Science Association, February 23, 1883].

This association was inaugurated May 1, 1880, and incorporated two years later by the State of Maryland. It is based upon the mutual assessment and insurance plan. For some time previous to its inception, the managers of the Baltimore and Ohio Railroad had been discussing the subject, but no definite action was taken until the railway systems of England and the continent had been carefully studied. The company subscribed $100,000 as the nucleus of a relief fund and issued a circular to its employés which explained the object and rules of the association.

The association is governed by Constitution and By-Laws, and its operations embrace three features: (1) an Accident feature; (2) an Annuity feature; (3) a Savings and Building feature.

In order to secure equitable rates the employés are divided into two classes: (1) Those engaged in operating trains and rolling stock; (2) Those not so engaged. The employés of both classes contribute a certain percentage of their wages, monthly and in advance, and are entitled to benefits in proportion to their contributions. The annexed table gives an idea of the method of assessment, as explained more at length by Dr. Wm. T. Barnard, of Baltimore, Secretary of the Association, in his second annual report, just issued (April, 1883).

The Association has as yet no hospitals of its own but special contracts are made with the leading hospitals along its line. The Savings Fund and Building Features have recently been added to the original plan for the following purposes: (1) To receive deposits, on interest, from those employés of the B. & O. R. R. Co., who are subscribers to its relief features, and from their wives; (2) To lend money, on approved security, to said employés at lawful rates of interest, in order to provide them with homesteads or to improve the same; (3) To acquire every description of freehold or leasehold property adapted for building purposes, and to sell or lease the same to the employés, in large or small quantities.

When the association first began its operations, membership was optional with the employés, but, success being assured, all were obliged to subscribe. In order to secure any of the benefits promised by the association, a contributor must relinquish all claims for damages against the Company, arising from disability or from death by accident. The advantages of the association may be extended to the employés of other roads, if the association deems it expedient. The managers are now discussing the propriety of establishing a circulating library for the benefit of the employés.

From May 1, 1880, the date of the organization, to December 31, of the same year, the receipts in gross were:

Dues from members	$85,543.26
Six months' interest on the Company's donation of $100,000 at 6 per cent	3,000 00
	$88,543.26

Amount carried forward,		$88,543.26
The disbursements were as follows:		
Allowance to members	$38,866.19	
Physicians' fees	2,636.95	41,503.14
Balance		$47,040.12

The aggregate receipts for the twenty-one months intervening between January 1, 1881, and September 30, 1882, were $345,088.30, and the disbursements for the same period amounted to $302,617.69.

SALARIES.	PAYMENTS PER MONTH.	BENEFITS.				
		1.	2.	3.	4.	5.
		In case of temporary disablement by accident, while in the discharge of duty the monthly payment, for a period not exceeding six months, of Per day	In case of permanent disablement and incapacity to resume employment arising from accident while in the discharge of duty, the monthly payment (after the 6th month) during continuance of such disablement, of Per day.*	In case of death arising from accident while in the discharge of duty, the payment to the legal representative, within sixty days after death of	In case of injury or sickness from any cause other than accident while in the discharge of duty causing total inability to labor, the payments (not longer than 1 year) of a daily allowance of	In case of death arising from any cause other than accident while in the discharge of duty, the payment to the legal representative, within sixty days after death of†
1. Those receiving $35 and under per month should pay	1st class $1.00 2d " 75c.	$ .50	$ .25	$500	$ .50	$100
2. Those receiving $35 and not more than $50, should pay	1st " $2.00 2d " 1.50	1.00	.50	1,000	1.00	200
3. Those receiving $50 and not more than $75, should pay	1st " $3.00 2d " 2.75	1.50	.75	1,500	1.50	300
4. Those receiving $75 and not more than $100, should pay	1st " $4.00 2d " 3.00	2.00	1.00	2,000	2.00	400
5. Those receiving $100 should pay	1st " $5.00 2d " 3.75	2.50	1.25	2,500	2.50	500

* Including free surgical and hospital treatment.
† Subject to increase predicated upon surplus at end of each year, now double this stated allowance.

The Editor of the **University Studies in Historical and Political Science** announces that arrangements have been made for the publication, in this series, of the following papers, in addition to those heretofore announced by him:

The Genesis of a New England State (Connecticut). By Alexander Johnston, A. M. Rutgers, 1870.

The Past and Present of Political Economy. Read before the Historical and Political Science Association, October 20, 1882. By R. T. Ely, Ph. D. Heidelberg, 1879.

Review of American Economic Literature since 1876. This review will first appear in Conrad's *Jahrbücher der National-oekonomie*, Halle. By E. J. James, Ph. D. Halle, 1877, and B. J. Ramage, A. B. Newberry College, S. C., 1880.

Taxation in the United States from 1789 to 1816. A revision of a thesis first published in the *Tübinger Zeitschrift*, 1879. By Henry C. Adams, Ph. D. Johns Hopkins University, 1878; Lecturer on Political Economy in the University of Michigan and at Cornell University.

An Essay on the Financial History of the United States during the Civil War. Read before the Historical and Political Science Association, February 10, 1883. By Arthur Yager, A. B. Georgetown College, Ky., 1879.

The Baltimore and Ohio Employés' Relief Association. Read before the Historical and Political Science Association, February 23, 1883. By B. J. Ramage.

The Study of Political Science in Continental Schools. By E. J. James.

The Growth of Internationalism. Read before the Historical and Political Science Association, May 19, 1882. Published in the *International Review*, April, 1883. By Albert Shaw.

THE DEVELOPMENT OF RENILLA.

By E. B. WILSON.

[Abstract of a paper communicated, through Professor Huxley, to the Royal Society, London, at its meeting, December 14, 1882, and reprinted from its Proceedings, No. 222].

The following abstract contains the more important points established by a study of the development of *Renilla*, which was carried on at intervals during three years at the marine laboratory of the Johns Hopkins University, conducted by Dr. W. K. Brooks. The need of farther studies on the embryology of polyps in general must be apparent to every zoologist; and *Renilla*, as a highly specialised form, presents a number of special morphological problems, which can only be solved by a study of the embryological history of the organism. This genus appeared, therefore, to be a doubly desirable object for study.

The paper is divided into four parts. The first comprises an account of the segmentation of the egg and formation of the germ-layers; the second a description of the formation of the tissues and organs of the primary or axial polyp; the third part treats of the formation of the colony produced by budding from the axial polyp; and the fourth deals with a few theoretical questions suggested by the phenomena observed. The leading points of the paper are as ollows:—

I.

(1.) As in other Alcyonaria, *Renilla* is diœcious, and fertilisation is effected in the water after discharge of the generative elements through the mouths of the feeding polyps. The ovarian or spermatic follicles are ruptured and cast aside at the time of spawning.

(2.) The action of the vitellus during segmentation is *extremely variable*, while the division of the nuclei appears to be nearly regular. The vitellus, after a preliminary division of the nuclei, may divide at the first cleavage into two, four, (?) eight, sixteen, or thirty-two spheres, which may be equal or noticeably unequal. In some cases cleavage begins at one pole a considerable time before any sign of activity is shown at the opposite pole, so that the segmentation appears precisely like that of a true meroblastic egg. In others, again, the segmentation is irregular and extremely unequal, so as to appear quite like that of an epibolic gastrula. All of these forms gave rise, however, to quite similar larvæ, which were proved by isolation in small aquaria to be normal and healthy.

In several cases of division into sixteen and thirty-two spheres, the vitellus was observed to undergo slight changes of form some time previous to actual division. These changes appear to be the expression of attempts at division on the part of the vitellus, which has not, however, energy enough to carry out a complete cleavage. In other cases the attempts are partially successful and the egg divides incompletely into spheres which do not become clear and well defined until the following cleavage. The series of forms appears to be produced by variations in the activity of the vitelline protoplasm or in the resistance (in the form probably of deutoplasm) which is opposed to it. The phenomena are of considerable interest, as showing how natural selection may find a field for action even in the earliest stages of an organism, and as a caution against drawing too hasty conclusions in regard to the character of segmentation from the study of a few individuals only. It is further remarkable to find the action of the vitellus and of the nuclei as independent of one another as these facts seem to indicate.

(3.) Cleavage is at first superficial, a considerable central mass remaining unsegmented. The furrows finally extend to the centre, and a small temporary segmentation cavity is formed.

(4.) The layers are separated by a process of delamination. The endodermic mass is at first solid and is not separated by a supporting lamella rom the ectoderm.

(5.) The supporting lamella is derived mainly from the ectoderm by a very peculiar process of secretion at the inner ends of the cells.

(6.) The gastric cavity is formed by absorption of the central endoderm cells by those which are more peripherally placed. The former undergo a peculiar process of disintegration and form a granular *débris* which is absorbed by the peripheral cells by a process which appears to be identical with the amœboid absorption of yolk observed by Reichenbach in the embryo crayfish. At this period the gastric cavity is without any communication with the exterior.

II.

(7.) The œsophagus is formed as a solid invagination of ectoderm, in which a slit-like cavity, elongated in the dorso-ventral plane soon appears. The lower end of the œsophagus is then absorbed, placing the gastric cavity for the first time in communication with the exterior. Much variation exists in the process of absorption. Most commonly it begins at one side, so that the bottom of the œsophagus hangs down like a valve from the opposite side. It is then absorbed bodily.

(8). The radial septa and the horizontal or peduncular septum differ widely in structure and mode of origin. The former arise simultaneously at the anterior end and grow backwards. Each septum consists of *two* layers of endoderm cells, separated by a structureless lamella. The peduncular septum arises at the posterior end and grows forwards. It is composed of *three* layers of endoderm cells, the middle of which atrophies. This septum is probably to be regarded as formed by the fusion of the dorsal pair of radial septa. The septa have a very marked bilateral arrangement.

(9.) The mesenterial filaments are formed as endodermic thickenings of the edges of the septa. After the formation of the mouth they become continuous with the invaginated ectoderm of the œsophagus. The filaments are arranged in pairs of different lengths and structure. The dorsal pair appears *last* and develops most slowly.

(10.) The tentacles appear simultaneously and are at first destitute of pinnæ. They arise as hollow cæcal outgrowths from the anterior extremities of the radial chambers.

(11.) The calyx-teeth are formed in a similar manner but in a definite sequence. The ventro-lateral pair first appear and then the median dorsal tooth. The remaining two pairs appear nearly at the same time, but the medio-lateral pair usually precedes the dorso-lateral. Occasionally, however, the reverse is true.

(12.) The muscles are entirely endodermic, with the possible exception of those of the tentacles. They are developed from the bases of epithelial cells, as "epithelio-muscular" cells or myoblasts. The cell-body, in many cases at least, becomes reduced to a small granular mass enclosing the nucleus and closely applied to the side of the fibre, and the entire muscle-element lies below the epithelium.

The muscles are arranged in two sets, longitudinal and circular, the latter being outside the former. The circular muscles form a nearly uniform sheet, but the longitudinal fibres are at first arranged in definite tracts which exhibit a striking bilateral symmetry.

(13.) The spicules are developed in the interior of cells and are of two kinds, ectodermic and endodermic, which differ widely in form and size. Professor B. K. Emerson has kindly examined them for me with the polariscope, and finds them to consist of a crystalline core, probably of aragonite, surrounded by an amorphous layer and this by a second crystalline layer, the axes of which correspond with those of the core.

(14.) The ventral chamber becomes closed in front by membranous outgrowths from the septa and body-walls. The dorsal chamber is closed by the forward extension of the fore edge of the peduncular septum, which finally unites with the dorsal wall of the body just anterior to the exhalent zooid (*vide infra*).

III.

(15.) The development of the buds is essentially like that of the axial polyp, but no trace of the peduncular septum is formed and the mesenterial filaments appear in a different sequence, the dorsal pair appearing first and developing most rapidly.

(16.) The buds which are to form sexual polyps appear always in symmetrically placed pairs, and, in the earlier stages, in a definite sequence. They are arranged in two simple lateral rows, which extend both forwards and backwards by the appearance of new buds upon the axial polyp. The backward extension is, however, limited, whence results the sinus, into which the peduncle is inserted. Anteriorly the two rows of buds extend forwards and downwards until they meet at the ventral side of the axial polyp, which is thus included within the disk.

New buds are constantly formed in the angles between older buds, and each lateral bud is in time enclosed by the younger adjacent buds in the same manner as the axial polyp.

(17.) The ventral sides of the buds are at first directed downwards, and hence, when the polyps in later stages bend upwards so as to assume a vertical direction, the ventral side is turned outwards, away from the centre of the disk.

(18.) The zooids develop in the same manner as the polyps and are indistinguishable from the latter in their early stages. They are at first single but soon multiply to form clusters, in which the ventral chambers of the zooids are always turned away from the centre of the group. The law of budding is therefore the same for the zooids and polyps. In rare cases the secondary zooids become in turn centres of multiplication according to the same law.

The axes of the primary zooids are definitely related to those of the polyps on which they are placed.

(19.) The "Hauptzooid" of Kölliker is formed at an early stage as a median bud upon the axial polyp, and its function is to discharge water from the colony. The other zooids draw in water from the exterior by the action of the cilia which line their cavities. This is true also of the sexual polyps in their early stages (though this function is entirely lost as they become older). Hence the zooids are physiologically, as well as anatomically, identical with the young polyps; they are, in other words, polyps in a state of arrested development.

The taking in of water is of vital importance to the organism, since the movements of the peduncle, by which the creature creeps, are effected by forcing the water to and fro. In this fact we find, probably, the explanation of the very early appearance of buds upon the axial polyp.

IV.

(20.) The facts of development, so far as they go, indicate the derivation of *Renilla* from a form related to the Bathyptileæ, which probably possessed a horny axis. This view is opposed to that of Kölliker, who considers that *Renilla* is related to the Penniformes only through a primitive simple "*Archiptilum.*"

(21.) The following section contains a brief discussion of the bilateral symmetry, which is strongly exhibited, both in the individual polyps and in the entire colony. It is shown that in both cases the bilateral structure is correlated with a bilateral environment, which indicates a causal relation between the two; and I conclude that the bilateral environment determines the bilateral structure.

(22.) The last section contains a discussion of the polymorphism of *Renilla.* An attempt is made to show that the zooids are probably not degenerated polyps but buds in a state of arrested development, whose direct ancestors never possessed a more highly organised structure than at present.

Other theoretical questions suggested by the investigation are discussed under the various sections in the body of the paper.

THE PHENOMENA PRESENTED BY THE ATMOSPHERE OF VENUS DURING A TRANSIT.

By CHARLES S. HASTINGS.

[Reprinted from "The Sidereal Messenger," February, 1883].

Mr. J. E. Keeler of Allegheny, Penna., has sent me an admirable drawing* of a singular phenomenon observed by him on the 6th of this month at that place, which was also seen independently from the same region by Professor Langley and Mr. Brashear, observing with different instruments. The last named observer has also sent me an interesting sketch of his observation. The phenomenon, briefly described, was a faint patch of light at the limb of *Venus*, exterior to the sun and not symmetrically placed with respect to the immersed segment of the planet. This patch of light, isolated when first seen at perhaps fifteen minutes before second contact, gradually extended around the planet so that a few minutes later it completed the outline. A probable explanation for this phenomenon and others which will be described in the course of this writing, is the object of the article.

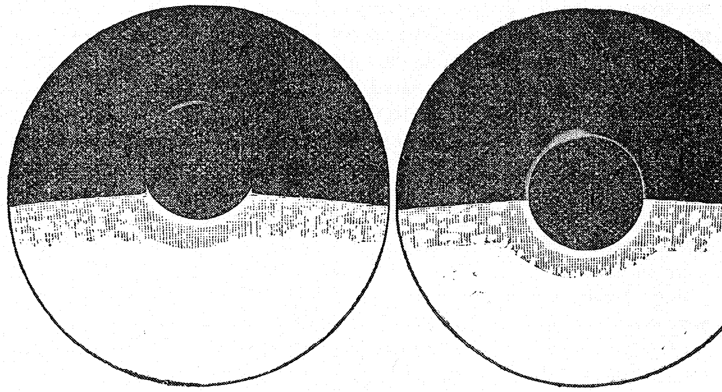
The simplest method to employ in acquiring a definite geometrical conception of the problems involved is perhaps the following: Let *C*, the place of the observer, be regarded for the moment as a source of light, and let us consider the course only of such rays as would fall upon the atmosphere of *Venus* and not be stopped by the planet. It is clear that such

*At the request of Dr. Hastings, of the Johns Hopkins University, I send to the *Messenger* the following account of a singular appearance presented by the ring of light surrounding the planet Venus between the times of first and second contacts, which I observed during the transit of Dec. 5th, but for which I was unable to afford an explanation.

I used a telescope 2¼ inches aperture and 4 feet focus, mounted on an equatorial stand in the open air, and having a positive eye-piece with power of 70, provided with a dark glass of a somewhat greenish tint. A mean time chronometer was placed in a convenient position for noting the time. As soon as first contact occurred, at $20^h\ 44^m\ 30^s$, I looked for indications of the atmospheric ring around the planet, having been requested by Professor Langley to pay particular attention to the physical phenomena of the transit, but for the first three or four minutes could see nothing of it. Shortly afterwards, however, I caught a feeble glimmer of light, almost star-like in appearance, on the limb of the planet farthest from the sun, which at $20^h\ 49^m$ presented the appearance of a curved streak of very faint silvery light extending for a short distance along the margin of the unimmersed portion of the planet's disc. The brightest part of this luminous arc was not directly opposite the sun, but was situated about 20° to the west of a line joining the centres of the sun and Venus. At the same time little horns of light, due, perhaps, to an optical illusion, appeared to rise from the cusps of the sun at the margin of the planet, like the elevated rim of fluid which surrounds an immersed body through capillary action.

As the planet advanced, the arc of light gradually extended and brightened, until at $20^h\ 54^m$, or nearly half-way between first and second contacts, the unimmersed portion was completely surrounded by a luminous ring. The light at the place on the margin when it was first noticed, however, much exceeded in brilliancy that of the adjacent portions, the brightest part extending along perhaps 30° of the planet's circumference, and on the western side the luminosity was more evident than on the eastern, when it was as yet barely discernible. The juncture of the luminous arc, first observed with the western cusp of the sun, to which it lay nearest, occurred before the eastern edge became visible. The marginal patch of light now presented the appearance of a local brightening of a continuous ring of light surrounding the planet, and according to my impression at the time, lay without its contour, although thin clouds which had begun to gather, causing the image in the telescope to "boil," rendered a definite conclusion difficult. An independent drawing by Mr. Brashear with a reflector of about six-inch aperture, represents this spot of light as extending within the planet. At $20^h\ 57.5^m$ the appearance was still marked, and the ring of light quite brilliant all around the planet. After this my attention was withdrawn from it in preparing to observe the second contact through the fast thickening clouds. At emersion the sky was completely overcast, and observation was impossible.

The phenomenon I have described was also observed by Professor Langley, with the large equatorial of the observatory, temporarily reduced to six-inches aperture, and by Mr. Brashear, of Pittsburgh, with a Newtonian reflector. Professor Langley estimated the centre of the brightest portion to be 30° from the line passing through the centres toward the west, giving a position angle 10° greater than that recorded by me at the time. As the position angle of the planet on the sun when half immersed was about 148°, the mean of these two independent estimates gives a position angle of 173° for the brightest part of the spot on the planet.



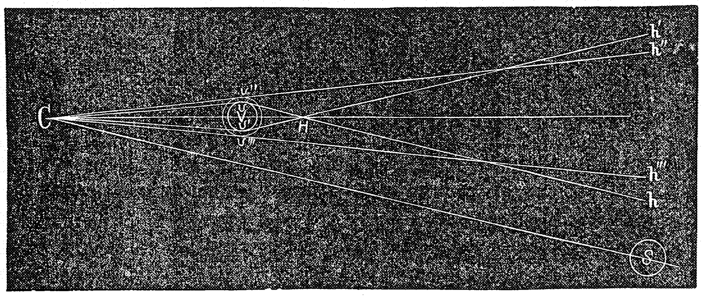
VENUS IN TRANSIT, DEC. 5, 1882.

Allegheny Mean Time $20^h\ 49^m$, 4.5m after 1st contact. Allegheny Mean Time $20^h\ 54^m$. 9.5m after 1st contact.

The appearance of Venus after the spot was first observed, and at $20^h\ 54^m$, when nearly half immersed, is represented in the accompanying drawing.

Allegheny Observatory, Dec. 27, 1882. J. E. KEELER.

rays would be contained within a hollow cone having C, for an apex and tangent to the two concentric spheres, one the atmosphere of *Venus*, and the other the virtual image of the planet. The diagram shows a meridian section of this double cone. After passing the atmosphere the whole



system of rays is contained within a volume of revolution which is best defined by its meridian section $v'' h''$, $v h$, $v' h'$, $v''' h'''$. One important consideration is readily deduced from the figure. In passing from h'' to h or from h''' to h', the quantity of light received from the side v or v', respectively, constantly diminishes; for if it were constant it would imply that the rays falling between v and v'' must be deflected directly according to their distance below v'', or in other words, that the effect of the atmosphere on a ray of light must increase directly as the depth of its path below the limit of the atmosphere, which is quite contrary to the known laws of variation of atmospheric density. For a similar reason the effect cannot be continually increasing. This conclusion would be true even if $v v''$ were not very small compared to Vv, as is assumed, though it could not be established by the reasoning given.

We can now not only determine how *Venus* would appear to an eye placed anywhere within the region just defined, but also, on account of the general principle in optics that the course of a ray is not altered by reversing the direction of propagation of light, we can state first how the planet would appear if the position of the eye and luminous point were interchanged. Thus if the eye is anywhere within the space $v H v'$, no light from C could be seen; anywhere on the axis of the cone beyond H a luminous ring could be seen concentric with the planet; within the cone $h' H h$, light might be seen on opposite sides of the planet; outside these two regions again, and within the boundary lines, light from one side only could be seen. If the position of the eye and C be changed in any case, the appearance is not changed. In the specific case of the effects produced by the sun entering the cone it is necessary to know the dimensions of the various elements indicated in the diagram. Fortunately a famous observation by Professor Lyman of Yale college yields the data necessary, for he found in 1866 that when *Venus* was 108′ from the nearest limb of the sun a complete ring of light might be seen about it. This makes the horizontal refraction of its atmosphere about 45′, or the total deviation of a ray which first passes the planetary surface $1\frac{1}{2}°$; hence the angle $h'' v h$ is $1\frac{1}{2}°$.

From this it readily follows, since $v'' C v'''$ is only 1′ at inferior conjunction, that the angle v H v', is 3°, and from the known diameter of *Venus*, the distance VH is about 144,000 miles and $V s$ 290,000; but the distance to the sun from the same point is 66,000,000 miles. If then the sun be imagined gradually moving into the space defined by the line hH refracted light may be first seen at the point v; this happens when the angle $V\ C\ S$ is about 108′. This light must be very faint, not only on account of the reasoning concerning the varying rate of refraction within the cone given above, but also because such light must have passed very close to the surface of the planet and have lost much by absorption due to suspended vapors and dust. Indeed, Professor Lyman could only detect this light when his telescope was in the shadow of a cloud or some other distant object.

There is another phenomenon presented by Professor Lyman's observation which, though quite unconnected with the matter concerning us here, might readily lead to confusion, namely, the appearance of *Venus* growing gradually from a crescent of a very little more than 180° compass until its cusps meet. Our reasoning shows that only the light on the opposite side from the sun comes to us by refraction, the rest comes by reflection from the body of the planet, and we see the crescent extending because, owing to the planet's atmospheric refraction, more than half its surface is illuminated by the sun. Just because, however, observation shows that this reflected light does not increase in intensity as the two bodies approach, it may be dismissed from farther consideration here as it is quite blotted out by our own atmospheric glare long before the beginning of a transit and thus does not contribute to the phenomena which we are studying.

To return to our diagram. As S moves onward in the direction before stated the amount of light refracted at v constantly increases by the addition of light which has passed through higher strata, until H h becomes tangent to the other limb of the sun, after which all the light refracted from the farther side comes from consecutively more and more elevated strata and consequently grows constantly in intensity. Not until the sun's limb reaches the line $v''' h''$, can any light be refracted from the nearer side to the place of the observer at C; but this condition corresponds with the epoch of first contact and consequently such refracted light would only appear as slightly increased illumination of the sun immediately adjacent to the planet. This, I think would always escape detection, or at least could not be distinguished from the very strong subjective effect due to the great contrast in brightness between the two bodies, which would be quite similar. The important fact is to be noted that this condition is true of every point of that half of the circumference of the planet nearest the sun, that is, that no point of that half can ever be recognized by refraction. As the sun becomes immersed farther in the cone, the light from the opposite limb not only increases in brightness but also in extent along the circumference of the planet, because the sun, having a large surface, cuts greater and greater portions of our imaginary cones. This progression continues until the limb of the sun comes to the axis of the system of cones at which moment there is a remarkable change in the law of increase of brightness in the atmospheric arc. Up to this moment the light has been constantly growing in intensity at the point opposite to the sun and at the same time extending on both sides towards the cusps of the interrupted limb of the sun; at this instant the light from the most distant region comes from all portions of the sun near the plane of the diagram, with a mean deviation of 16′ and a minimum deviation of $\frac{1}{2}$ minute. The light from the extremities of the planetary diameter tangent to the sun's limb comes only from the single point of the sun which is in line with the centre of the planet. A moment later the light from that portion of the atmospheric ring adjacent to the solar limb comes from all portions of the sun near the chord joining the cusps; but, as is evident, this comes with small deviation and consequent brilliancy. Hence, although the region of the limb remote from the sun is still increasing regularly in brightness, that close to the sun has taken a sudden increment in brilliancy, which must grow until it quite outstrips that of the former region.

We are now prepared to trace all the changes which a telescopic view of *Venus* as she approaches the sun in inferior conjunction would present us. First, the crescent would grow gradually more slender, its horns extending more and more beyond the limits of a diameter until when the planet is separated little more than 1° from the sun, the cusps would meet and form a ring, thicker, however, on the sunward side. This is the phenomenon observed and described by Professor Lyman. A little later, at a time depending on atmospheric conditions, the planet would totally vanish, in the intense glare surrounding the sun. The next view would be that of the edge more distant from the sun, which would be outlined by an arc of light increasing in brightness and extent with increasing nearness. This the Pittsburgh observers alone seem to have seen, as the observation would demand a purity of sky which was little likely to occur at any place in the United States. One characteristic feature, however, has not been touched upon in our explanation, namely, the non-symmetrical character of the phenomenon; but we find a suggestion of the cause in the demonstrated fact that this light must have passed through relatively low regions of the planetary atmosphere, hence if there were any local differences in transparency due to cloud formations, etc., such a non-symmetry must have resulted. Indeed, if we are guided by analogies drawn from our own atmosphere, we must conclude that such a want of symmetry is more probable than not.

After the centre of the planet has reached the limb of the sun there would result a rapidly growing intensity of illumination of the atmospheric ring near the cusps, which would speedily outstrip the brilliancy of the more distant portion. This phenomenon, which was doubtless seen by most observers much as it was by the writer, I caught just $4^m\ 40^s$ before second contact, through rather a milky sky, as two slender horns of light shooting out from the solar cusps. One minute and twenty-five seconds later they had met and after that there was a continuous growth in brightness. The phenomena observed after third contact were exactly the same, even the noted times being closely accordant.

JOHNS HOPKINS UNIVERSITY, *Dec.* 23, 1882.

RECENT PUBLICATIONS.

PEABODY INSTITUTE. Catalogue of the Library of the Peabody Institute of the City of Baltimore. (*Baltimore, The Peabody Institute, 1883*).

By the kindness of Dr. N. H. Morison, Provost of the Institute, the University has received advance sheets of the Parts I, II, (A–B) of the Peabody Library Catalogue.

The laboriousness of the task which has now been going on for fourteen years, may be estimated from the fact that these two letters alone contain nearly 36,000 references, to which C will add about 20,000 more. The system of cataloguing adopted was mainly founded on Panizzi's rules for the British Museum Catalogue, and on the Catalogue of the Boston Public Library, prepared by Mr. Jewett; but several peculiar features have been added.

The dates of the birth and death of each author, so far as ascertainable, are entered under the author's name in the general catalogue; and great pains have been taken to make these dates as complete and accurate as possible.

Another feature is the separation, under subject-headings, of the books from the essays, reviews, and articles in books; the titles of books being placed first, in larger type, and followed by the articles, &c., in a smaller letter; both being alphabetically arranged.

The contents of books are arranged alphabetically, not by the first word, but by the first important word in the heading, wherever it may happen to stand; this word being made conspicuous by bold-faced type. This feature, which is believed to be novel, greatly facilitates the finding of any article in a long list.

Much care has been taken in analysing long sets, such as Migne's great collection, those of Graevius, Bouquet, the Archaeologia, &c., as well as the literary, historical, and antiquarian serials.

Other features of excellence will be noted by those who use this catalogue, which greatly enhances the practical value of this admirable library, by placing in the hands of those who use it, a ready key to its varied treasures.

CRAIG, T. On the Parallel Surface to the Ellipsoid. (*Journal für die reine und angewandte Mathematik.* Bd. 93. Berlin, 1882).

The surface may be considered as generated by a given point on a straight line which moves so as to be always normal to the ellipsoid in a second given point. In general, every point on a straight line moving so that it is constantly normal to a given surface at a given point of the line describes a parallel surface. The parallel surface may also be conceived as the envelop of a sphere of constant radius, moving with its centre always on the given surface — or as the envelop of a sphere of constant radius which rolls over the entire given surface, *i. e.*, rolls over both sides of the surface The general equation of the parallel to the ellipsoid is obtained in the present paper, but not expanded. The partial differential equation is also written down, and after that the surface is studied by its representation by three equations, giving the coordinates x y z in terms of two independent variable parameters u and v. The sections of the surface are examined, and all the important formulæ necessary for a study of the curvature of the surface are obtained. This paper will be followed by another brief one, treating of the quadrature of parallel surfaces.

CRAIG, T. A Treatise on Projections. (*U. S. Coast and Geodetic Survey, 1882, pp. 247, 4°*).

"In this paper an attempt has been made to give a sufficiently comprehensive account of the theory of projections to answer the requirements of the ordinary student of that subject. The literature of projections is very large, and its history presents the names of many of the most eminent mathematicians that have lived between the time of Ptolemy and the present day. In the great mass of papers, memoirs, &c., which have been written upon projections there is much that is of the highest value and much that, though interesting, is trifling and unimportant. Thus many projections have been devised for map construction which are merely elegant geometrical trifles. Although in what follows the author has taken up every method of projection with which he is acquainted, he has not thought it necessary in the cases referred to to do more than mention them and give reference to the papers or books in which they may be found fully treated.

As the different conditions which projections for particular purposes have to satisfy are so wholly unlike, it is necessary, of course, to have a different method of treatment for the various cases. Thus no general theory underlying the whole subject of projections can be given. Perhaps the only division of the subject — omitting the simple case of perspective projection — that has ever been fully treated is that of projection by similarity of infinitely small areas. This is a most important case, the general theory of which, for the representation of any surface upon any other, has been given by Gauss. The mathematical difficulties in the way of such a treatment of equivalent projections and projections by development seem to be insurmountable, but certainly offer a most attractive field for mathematical research. The author has attempted to add a little to what is already known on these subjects, but feels that what he has done is of little consequence unless, indeed, it should tempt some abler mathematician to take up the subject and develop it as it deserves. A few of the solutions of simple problems in the paper, it is believed by the author, are new and simpler than any he was able to find in the writings of others. The solution of the problem of the projection of an ellipsoid of three unequal axes upon a sphere by Gauss's method is also believed to be new. With these few exceptions there is no claim to originality in what follows; the attempt having simply been made to present in as simple and natural a form as possible what others have done. The two treatises on projections from which much aid has been obtained are those by Littrow and Germain. Littrow's Chorographie, which appeared in Vienna in 1833, was at that time a most valuable work, but is at the present day too limited in its scope to be of very much use to the student. Unquestionably the most important treatise on the subject at this time is Germain's "*Traité des projections*," which contains an account of almost every projection that has ever been invented. The author is under much obligation to this work, both for references to original sources and for solutions of particular problems. In cases where processes or diagrams are taken from this work that are by the author supposed to have been original with M. Germain, special mention of them is made in the text; when, however, Germain has drawn from earlier sources, no mention is made of his book, but as far as possible references to the original papers are given. The opening brief chapter on conic sections has been taken in great part from Salmon's Conic Sections. The object of that chapter is only to give in a simple manner some of the more important and elementary properties of the curves of the second order, so that convenient reference could be made in the subsequent part of the paper to the various formulae connected with these curves, and also simple means given for constructing them. At the request of Superintendent Carlile P. Patterson the paper has been divided into two parts. The first part contains the mathematical theory of projections, while the second part contains merely such a sufficient account of the various projections as will enable the draughtsman to construct them."—*Extract from the Preface.*

MORRIS, G. S. Kant's Critique of Pure Reason. A Critical Exposition. (*Chicago: S. C. Griggs & Co., 1882, pp. xvi, 272*).

The author aims in this volume to exhibit succinctly the substantial contents of Kant's *Kritik der reinen Vernunft*, and to furnish a critical estimate of its philosophical value and significance. To this end, in the Introduction, the universal nature and historic results of philosophic inquiry are briefly sketched; and then, in the body of the work, the exposition proceeds by a way intended to indicate (1) the starting-point of Kant's *Kritik*, (2) the goal of demonstration actually reached in the *Kritik*, and (3) the further goal, not reached in the *Kritik*, but to which the latter both positively and negatively points.

This volume was the first one to appear in a series of "German Philosophical Classics for English Readers and Students," under the general editorial direction of the author. Beside it, there has already been published in the same series "Schelling's Transcendental Idealism," by Prof. John Watson, of Queen's University, Kingston, Ontario; and the following are in preparation:

Leibnitz's New Essays. Prof. G. H. Howison.
Kant's Ethics. President N. Porter.
Kant's Aesthetics and Natural Theology (Kritik der Urtheilskraft). Prof. Robert Adamson, Victoria University, Manchester, England.
Fichte's Science of Knowledge. Prof. C. C. Everett, Harvard Divinity School.
Hegel's Logic. Dr. W. T. Harris.
Hegel's Philosophy of Religion. Principal A. M. Fairbairn, Airedale College, Yorkshire, England.
Hegel's Aesthetics. Prof. J. S Kedney.

The series, according to the present plan, will be completed with the addition of a volume on Hegel's Philosophy of History and the State.

Rowland, H. A. Relazione Critica sulle varie determinazioni dell' Equivalente Meccanico della Caloria. (*Opera Premiata dal Reale Istituto Veneto, Atti, Serie V, T. VII, pp. 120, 8°.*)

This is the Italian translation of a paper sent to Venice in March, 1880, in response to an announcement of the Venetian Institute that a prize would be given for the best essay on the subject. It embodies in part a revision of Rowland's communication (published by the American Academy of Arts and Sciences) on his own investigations, and also critical and historical comments on previous determinations of the same constant.

The circumstances which led to the award are thus narrated in the report of the committee to whom the competing manuscripts were referred.

[*Translation.*]

Four years ago our Institute announced a competition for a prize of 1500 lire on the following subject:

"To discuss in detail the determinations hitherto made of the mechanical equivalent of heat; to investigate the causes of the remarkable differences which are found in the results; to point out what is the most probable value that can be obtained from these results; and to determine the equivalent itself by new experiments according to the method which the competitor shall have proved to be the most exact."

Two competitors presented themselves, one with a short memoir in Italian, inscribed with the motto: "*Provando e riprovando;*" the other with a voluminous English manuscript which bore the motto: "*Veritas vos liberabit.*"

The examination of these two memoirs was intrusted by you to the committee which has now completed its task.

. . . . A memoir of much greater breadth and importance is contained in the English manuscript inscribed "*Veritas vos liberabit.*"

. . . . Your committee is happy to be able to state that the author has completely exhausted the first portion of the subject, and that too in such a way that it would be impossible to imagine a better treatment of the subject. The second part, it is true, is wanting. In order to justify this omission it will be well to recall a fact relative to the preparation of this memoir, which was mentioned to the Institute by our Secretary at our meeting last year. He said in fact that within the time laid down for the competitions of that year there had come from Baltimore an English memoir with the motto "*Veritas vos liberabit,*" and he expressed the earnest wish that he might be able to communicate with the unknown author to let him know that the competition did not expire before March 31, 1881.

A letter which the author sent last year together with the memoir proved unquestionably that he was led into error not only with regard to the time when the competition closed, but also with regard to the existence of the second part of the subject.

"It may be, he says in his letter bearing the date of March 11, 1880, that I have not fully satisfied the formal conditions of the competition; but in spite of all my researches in Washington and in Boston, the only information which I have been able to obtain is that given by the English paper "*Nature,*" No. 13, for January, 1880."

Your committee took pains to look at the announcement given by *Nature*, which is worded as follows: "The Institute of Venice opens a competition for a prize of L. 1500 for a detailed description of the determinations hitherto made of the mechanical equivalent of heat, for the investigation of the causes, etc. Limit for the competition, March 31, 1880."

Two reasons then have contributed to prevent the author from entering on any new experiments. The principal cause was that he did not know that the subject set for competition included the performing of new experiments. A second and sufficiently powerful reason consisted in the shortness of the time, since the author had only a single month at his disposal. It would have been impossible for any one in so short a time to present a work so extended, profound, and exhaustive, if the author had not already long busied himself with investigations analogous to those required by the subject proposed by our Institute, and had not already had at his hand all the materials necessary for its solution.

This fact also can be explained to a certain extent by your committee.

In June, 1879, Henry A. Rowland, Professor of Physics in the University of Baltimore, laid before the American Academy of Arts and Sciences a voluminous and very important memoir "on the mechanical equivalent of heat with subsidiary researches on the variation of the mercurial from the air thermometer, and on the variation of the specific heat of water." This memoir was printed in the Proceedings of that Academy and also separately in Cambridge in the beginning of the year 1880.

Now the memoir presented to our competition contains a large portion of Rowland's memoir. Let it not, however, be believed to be a case of plagiarism. Our author quotes Rowland with scrupulous exactness, both when he gives his actual words and also when he only gives the substance of one of his paragraphs. Besides there are many variations.

The resemblance between the portions borrowed from Rowland and the portions introduced by our author is so great, that it would seem as though Rowland himself, wishing to conform to the subject proposed by our Institute, had cast anew his former work, arranging it in a different order agreeably to the requirements of the subject, and making in it such emendations and corrections as seemed to him necessary for his purpose.

However this may be, our anonymous author in the last part of his memoir finds the mean value given by each method, assigning a varying importance to the determinations of different investigators, and then finds the mean value of these means themselves, each estimated proportionately to the varying excellence of the method by which it was obtained. By the method of the theory of gases he obtains the mean value of 430.7; by means of the heat generated by electric currents the value of 428.4; from the experiments performed by Joule in 1850, he obtains the mean value of 426.4; and from Rowland's experiments (1879) the value 427.7; and giving an importance equal to 1 to each of the first two methods, an importance equal to 3 to the third and fourth method, and an importance equal to 10 to the last method, he reaches the conclusion that, at the latitude of Baltimore and under a temperature of 13.9° C., the mechanical equivalent of heat is expressed by 427.62 kilograms, a value almost identical with that found by Rowland, and therefore almost identical with the value deduced from the other determinations.

Considering that the author of the memoir "*Veritas vos liberabit*" has admirably solved the first part of the subject, *i. e.* the most important part and the one most useful to science, and giving due weight to the reasons owing to which the second part could not be done, your committee is of opinion that this memoir deserves the prize, and proposes therefore that the Institute should bestow on the author the sum of L. 1500, the amount of the prize announced for the subject of this competition.

DOMENICO TURAZZA,
ANTONIO PAZIENTI,
FRANCESCO ROSSETTI.

The conclusions of the committee having been approved by the Institute, the note of the memoir bearing the motto "*Veritas vos liberabit*" was opened, and the author was found to be Prof. Henry A. Rowland, of Baltimore.

Jameson, J. F. Montauk and the Common Lands of Easthampton. (*Magazine of American History, April, 1883, pp. 7, 8°.*)

This paper was read before the University Historical and Political Science Association (April, 1882), and an abstract is given on page 208 of *University Circular, No.* 15.

Harris, J. Rendel. New Testament Autographs. (*Baltimore, 1883, pp. 54, 8°, 4 plates; 50 cents*).

Mr. Harris has shown by arguments of mathematical cogency that the Vatican and Sinaitic MSS. were copied from originals with pages of a different size: that the στίχος of the Vatican MS. was identical with that which M. Ch. Graux proved to be the normal length of the dactylic hexameter verse; while that of the Sinaitic MS. was as clearly of a length corresponding to the iambic senarius. In this way he establishes what he designates as the V-page and the S-page; and having secured these standards he proceeds to apply them to the solution of various questions of extreme interest. The critical path thus opened by Mr. Harris is likely to lead to many important results, but it has of course as yet been very little explored. All however who care for questions of New Testament criticism will be interested in knowing that the passage in St. John's Gospel concerning the Woman taken in Adultery, which even conservative critics have found it hard to defend where it stands, occupied precisely four V-pages—here reproduced in a conjectural facsimile, which shows the texture of the papyrus and the joining of the separate sheets—which must have been lost from the original document before it came into the shape represented by Codex B; and that when restored they were inserted in a place which they did not previously occupy: and it is further shown that the passage should probably be placed at the end of the fifth chapter. It is not only in the settlement of the New Testament text that Mr. Harris's method is likely to prove fruitful, but also in determining similar problems in regard to other ancient writings; and it is shown in fact in this essay that it would be possible to print the letters of Pliny approximately as they must have appeared in their autographs.

The interest attaching to these investigations induced the Editor of the *American Journal of Philology* not to postpone the publication of an account of them till room could be found for it in the regular numbers of the *Journal*, but to issue a supplementary part devoted expressly to it. In this way too, it was expected that the subject might be brought to the attention of many who take a deep interest in the questions and methods of New Testament criticism, but do not regularly see the *Journal* itself. The nature of Mr. Harris's method can be properly appreciated only by a study of the essay at length; and indeed it would be impossible in this notice to give even an approximate impression of the cumulative force of the argument, illustrated as it is by tables and lithographed reproductions of the probable pages of the original autographs.

Gilman, D. C. James Monroe. (*American Statesman Series, Boston: Houghton, 1883, pp. 300, 12°*).

This volume, which was prepared at the request of the editor of the series, presents some fresh information in regard to James Monroe derived from an examination of his unpublished writings. In the appendix there is an elaborate Bibliography, by J. F. Jameson, Ph. D., relating to the Monroe Doctrine, as well as to the life of Monroe.

Adams, H. B. Saxon Tithingmen in America. (*University Studies in Historical and Political Science, No. IV, pp. 23, 8°; 25 cents*).

This paper was read before the American Antiquarian Society, October, 1881, and before the University Historical and Political Science Association, December, 1881. An abstract is given on p. 176 of *University Circular, No.* 13.

Bemis, E. W. Local Government in Michigan and the Northwest. (*University Studies in Historical and Political Science, No. V, pp. 25, 8°; 25 cents.*)

This paper was read before the University Historical and Political Science Association, (January, 1881), and before the American Social Science Association, (September, 1882). An abstract is given on p. 130 of *University Circular, No.* 10.

Ingle, E. Parish Institutions of Maryland. (*University Studies in Historical and Political Science, No. VI, pp. 48, 8°; 40 cents.*)

This paper was read before the University Historical and Political Science Association, (May, 1882), and an abstract is given on page 238 of *University Circular, No.* 17. It is also published in an abridged form in the Magazine of American History, April, 1883.

SYNOPSIS OF THE RECENT SCIENTIFIC JOURNALS

Published here.

American Journal of Philology. Edited by PROFESSOR GILDERSLEEVE. *Vol. III. Whole No.* 12.

Article I.—Eggeling's Translation of the Çathapathabrāhmaṇa, by WILLIAM DWIGHT WHITNEY.

The Brahmaṇas come next after the Vedic hymn texts. They are products of the schools of priests engaged in the practice and propagation of the sacrificial ceremonies and in the study of their value and application. They describe the ceremonial and give the dogmatic basis of the vast and intricate science of sacrifice. We have here one of the aberrations of the human mind, but one which is of a high interest and necessary to be understood, and the more as it is a step in the religious development of a great and gifted people. Moreover the Brāhmaṇas are the oldest body of Indo-European prose, of a generally free, vigorous, simple form, affording valuable glimpses at the primitive condition of unfettered Indo-European talk, which part of their value has been especially brought out by Delbrück. And their language is of an older cast than the classic Sanskrit, being in many respects intermediate between the latter and the yet older Vedic dialect. For these reasons, and in spite of their tedious inanity, they are full of interest, almost of charm to the special student, and Professor Eggeling's translation is a highly interesting and important volume, and in Professor Whitney's judgment, by far the most legitimate and acceptable contribution to the world's knowledge of the religious history of ancient Brahmanical India made in Müller's series of the Sacred Books of the East.

The Brāhmaṇas are all joint survivals out of one age of production and tradition; but another generation of scholars will pass, in all probability, before they will be sufficiently worked up to allow of our holding definite and defensible views as to their history. Not all of them are yet accessible in print, and the enterprise of Professor Eggeling is by far the most considerable that has been undertaken in this department, and yet the present stout volume contains just one-fifth of the Brāhmaṇas. Professor Eggeling has executed his task very well. He is a competent translator in both departments of the work—in general accuracy of scholarship and familiarity with the Brāhmaṇa style and in comprehension of the processes of the ceremonial and knowledge of its technical vocabulary. [The rest of Professor Whitney's article is taken up with a detailed criticism of the translation].

Article II.—On the Locality to which the Treatise of Palladius *De Agricultura* must be assigned, by J. RENDEL HARRIS.

[This paper was read before the Johns Hopkins Philological Association, Oct. 6, 1882, and an abstract may be found on p. 6 of the *Circular* for Nov., 1882].

Article III.—On some Points of Usage in English, by FITZ-EDWARD HALL.

This essay was suggested by some remarks of Professor Short in the *American Journal of Philology* (*Vol. III, pp.* 141-169) on the English of the Revised New Testament. Dr. Hall has presented a large collection of singular verbs with compound subjects, ranging from the fifteenth century to the nineteenth, a long list of names of rivers used without the article, and a number of examples of duplicated prepositions such as we find in "cast out the mote out of," with incidental notes on other points of usage.

Article IV.—Studies in Pindaric Syntax, by the EDITOR.

An abstract of this paper is given on p. 68 of this *Circular*.

Article V.—On a Probable Error in Plutarch, Per. c. 23, by C. D. MORRIS.

[This paper was read before the Johns Hopkins Philological Association (Dec. 8, 1882), and an abstract will be found in the *Circular* for Feb., 1883, p. 52].

In the *Notes*, Professor J. M. HART brings forward confirmation of his view expressed in the *American Journal of Philology* (*I*, 442), that in the Leabhar Breac the commentator on the canon of the mass presupposes a commingling of the elements in the chalice by pouring the wine upon the water, which symbolized the adding of the divine nature of Christ to humanity; Professor F. D. ALLEN publishes a short Aeolic inscription from Assos, and Professor H. E. SHEPHERD cites from the writings of J. C. Calhoun the word 'occlude,' which is marked as obsolete in all our American dictionaries, [and which is used every day of the world by physicians].

This number contains further *Reviews* of *Haupt's Akkadische Sprache*, by Professor J. F. MCCURDY; of *Zahn's Cyprian von Antiochien*, by Professor J. M. HART; of *Monro's Homeric Grammar*, by Professor T. D. SEYMOUR; of *Kluge's Etymologisches Wörterbuch*, by Professor S. PRIMER; of *Horstmann's Altenglische Legenden*, by Professor JAMES M. GARNETT; of *Hauler's Terentiana*, by DR. M. WARREN; of *Seuffert's Deutsche Litteraturdenkmale*, by Dr. JULIUS GOEBEL, and of *Bücheler's Petronius*, by Professor ROBINSON ELLIS.

The *Reports* give abstracts of *Fleckeisen's Jahrbücher*, *Revue de Philologie*, *Mnemosyne*.

In the *Correspondence* Dr. M. BLOOMFIELD and Rev. L. H. MILLS give a detailed account of the work of the latter scholar on the Gâthâs.

This is the last number of the third volume. The offer of the management to reduce the price of *Vols. I* and *II* still holds. Either of these volumes can be had for $2 until further notice. *Vol. III*, which contains not only the four regular numbers (522 pp) but a supplement of 54 pages with illustrations, may be had at the regular subscription price ($3). THE MANAGEMENT HAS DETERMINED TO KEEP ONLY A SMALL RESERVE AFTER SUPPLYING ACTUAL SUBSCRIBERS, AND APPLICATION SHOULD BE MADE WITHOUT DELAY TO THE EDITOR, P. O. DRAWER 2, BALTIMORE, MD.

Vol. IV, 1, (Whole No. 13) of the AMERICAN JOURNAL OF PHILOLOGY is in press. It will contain articles on the *Color System of Vergil*, by T. R. PRICE (see *Circular*, *No.* 15, *p.* 205), on the *General Theory of Greek Accentuation*, by M. BLOOMFIELD (see *Circular*, *No.* 21, *p.* 66), *Etymological Notes*, by J. P. POSTGATE, and minor communications by H. NETTLESHIP, M. WARREN, H. E. SHEPHERD, with a number of short *Reviews* and *Reports* of *Hermes*, *Mnemosyne*, *Germania*, etc.

American Journal of Mathematics. Edited by PROFESSOR SYLVESTER. *Vol. V, No.* 3.

Article I.—On the Non-Euclidean Geometry (*conclusion*), by W. E. STORY.

Article II.—On Cubic Curves, by F. FRANKLIN.

Article III.—On the Solution of the Differential Equation of Sources, by J. HAMMOND.

Article IV.—Bibliography of Bernouilli's Numbers, by G. S. ELY.

Article V.—On Division of Series, by REV. JOHN HAGAN, S. J.

Article VI.—Sur le Développement des Fonctions Rationelles, by REV. FAÀ DE BRUNO.

Article VII.—Tables of Generating Functions Reduced and Representative by certain Ternary Equations, by J. J. SYLVESTER.

Article VIII. A Constructive Theory of Partitions arranged in Three Acts, an Interact, and an Exodion, by J. J. SYLVESTER.

American Chemical Journal. Edited by PROFESSOR REMSEN. *Vol. V, No.* 1. (*April*, 1883).

Article I.—On some Reductions with Zinc and Ammonia, by W. G. MIXTER.

Article II.—On the Distribution of Arsenic in a Human Body, by R. H. CHITTENDEN.

Article III.—Hydrated Carbon Disulphide, by F. P. VENABLE.

Article IV.—An Isopicraminic Acid, by CHARLES W. DABNEY, JR.

Article V.—Piscidia, the Active Principle of Jamaica Dogwood (Piscidia Erythrina), by EDWARD HART.

Article VI.—Estimation of Chlorine, Sulphuric Acid, and Chromium in the presence of Organic Matter, by CHARLES T. POMEROY.

Article VII.—Methods of Analysing Samarskite, by J. LAWRENCE SMITH.

Article VII.—A Method for the Preparation of Carbon Monoxide, by L. P. KINNICUTT.

Reviews and Reports.

The Present Condition of the Soda Industry, by W. WELDON.

Recent Researches on the Pyridine and Quinoline Bases.

Researches on Caffeine.

The number closes with various notes by F. H. STORER, W. A. NOYES, J. R. DUGGAN, and others.

Studies in Historical and Political Science. Edited by DR. H. B. ADAMS. *Nos.* 4, 5, 6.

See list of Recent Publications, p. 82.

CORRESPONDENCE.

Extracts of Letters to PROFESSOR SYLVESTER, *from* MR. J. HAMMOND, of Buckhurst Hill, Essex, England.

January 23d, 1883.—When I saw your question in the *Educational Times*, on a succession of integers, etc., No. 7219, I thought you had been trying the *American Journal* Prize Question, but did not think that either a proof or disproof could be obtained that way, especially when I considered the difficulty of finding a rule to fit the case of weight 11, in which the Postulate holds for Quantics of all orders to infinity, with the single exception of the Septimic, viz: for the Quintic and Sextic there are ground-forms of deg-order (5.3)(5.8) but no syzygants of the same type, for the Septimic both a ground-form and syzygant of deg-order (5.13), for the Octavic and all superior Quantics syzygants but no ground-forms of the same type. This result is, as you observe, a startling one; my first impression, when I made the discovery at the end of November, was that there was some flaw in my reasoning; when I could find none, I had some misgivings as to the correctness of the printed expressions for the generating functions given in the *Journal*, and it was only after three days' consideration, and after counting the partitions more than once, to verify my result, that I was so far convinced of its truth as to venture to send it for publication. My second note followed, the results announced in which are not yet arranged as I should wish them to be, but they will lead to an *automatic method of tamisage*, which will be found to save labor. By this method I have performed the tamisage for Quantics of all orders up to 8, and found the same results as printed in the *Journal*. I have not tried it on higher Quantics, as I consider that this gives a reasonable assurance of the correctness of the method. . . . .

Since then I have resumed a subject that was interrupted by the Prize Question, viz.: the Symmetric Functions of the roots of an equation; my first imperfect views on this subject are printed in the Mathematical Society's proceedings. In the paper I am now writing, as a sequel to this, is a general expression for Σa^n and a proof of Prof. Cayley's law of symmetry given at the end of the tables in Salmon. . . . .

All my papers have been solutions of doubts and difficulties that presented themselves to my mind, and, I believe, have been more instructive to myself than to anyone else. The case of the Prize Question has been no exception to this; I have learned more in solving it than anyone else can in reading my solution.

Starting with a bare knowledge of the meaning of the words "Ground-form" and "Syzygant," obtained from the *Journal*, the method of obtaining Ground-forms given in the *Journal* and that briefly mentioned in Salmon, my first difficulty was how to obtain syzygants without assuming the Fundamental Postulate. After getting over this, and seeing how many of the syzygants may be obtained (all, if one could examine each particular case), the question deluded and deceived me for some months, when, to my surprise, I found that in one simple case I obtained a syzygant where the Postulate said there was none. . . . .

February 3, 1883.—I seize pen and paper to communicate a discovery I have this instant made. There is a ground-form for the Binary 9-ic of deg-order (5.19).

The number of linearly independent forms is 7; the compound forms are (1.9)(4.10), (1.9)(4.10), (2.2)(3.17), (2.6)(3.13), (2.10)(3.9), (2.10)(3.9) (2.14)(3.5) also 7 in number; and the syzygant is $C_9 Q_4 - C_5 Q_8 = V(*)$ with the notation of my paper.

This form I found by searching, the former was obtained by chance. . . .

February 5, 1883.—In continuing my search for cases of co-existence of Ground-form and Syzygant, I have to-day found three new cases, making, with my former two, five in all, viz.:

The case (5.13) for the 7-ic } already given.
" (5.19) " 9-ic }
2 of deg order (5.25) for the 11-ic,
1 " (5.15) " 9-ic.

To give the reasoning would, in each case, be only to repeat the reasoning of the last article of my paper on the Solution of the Differential Equation.* The Syzygants of the respective types are all of the same form, viz:

$$Q_4C_7 - C_5Q_6 = V(*) \text{ (5.13) for 7-ic,}$$
$$Q_4C_9 - C_5Q_8 = V(*) \text{ (5.19) for 9-ic,}$$
$$Q_4C_{11} - C_5Q_{10} = V(*) \text{ (5.25) for 11-ic,}$$
$$Q_6C_9 - C_7Q_8 = V(*) \text{ (5.25) for 11-ic, and (5.15) for 9-ic.}$$

This last case rather staggers me, as it is a case where (if the tables in the *Journal* are correctly printed) there are two ground-forms found by tamisage, which shows that tamisage will not give all the ground-forms that correspond to the first positive block of the numerator of the Representative Generating Function.

I do not think, however, that this will destroy my proof that all the ground-forms found by tamisage come from the first positive block.

*I add, to prevent misconception, that I have not gone into the *realistic* reasoning of any case except the original (5.13), all the others were obtained by *idealistic* reasoning.

[It is, perhaps, unnecessary to add that here, as in my paper,

$$Q_{2m} = a_0a_{2w} - 2ma, a_{2m-1} + \cdots$$
$$C_{2m+2} = a_0^2a_{2m+1} - \&c$$
$$V = a_0].$$

March 8, 1883.— . . . When I first wrote (December 2) I believed equation (9) of my paper to be my own, but afterwards found that you had given the same result applied to a system of quantics instead of a single quantic only on p. 119, Vol. I, of the *American Journal*. Something very much like it is also given in *Hargreave's Essay on the Resolution of Algebraic Equations* (1866), where, on p. 8, he says: "The linear transformation shows not only that the discriminant of a quantic, but that every combination of the roots or coefficients of a quantic whose vanishing denotes the condition or one of the conditions of some system or systems of equalities between the roots, (for example, all the leading Sturmian coefficients of the quantic), admits of being expressed in terms of the $(n-1)$ quantities (12), (13), . . . , $(1n)$.

These $(n-1)$ quantities of Hargreave's are all of them differenciants, but only two of them, (12) and (13), are protomorphs; they form a series in which the degree and weight are equal, since their first terms are respectively a_1^2, $2a_1^3$, $3a_1^4$, $4a_1^5$, ... The use of these seems to complicate Hargreave's results unnecessarily; for example, on p. 9, he says: "The discriminant of the quartic admits of being placed in the form

$$27\left((12)^3 + (12)(14) - (13)^2\right)^2 - \left(3\,(12)^2 - (14)\right)^3.$$

I wish to make one short remark on the use of generating functions which will, I believe, bring your results in Vol. V. of the *Journal* into complete accordance with mine. In any case where generating functions are used there is a liability of error arising from the fact that $1 - 1 = 0$, both units having disappeared and left no trace of their former existence. Now it has been conclusively proved (*American Journal*, Vol. V., p. 117) that compound syzygies and ground-forms of the 7th degree and the same weight coexist for any quantic whose order is sufficiently great, and the error about to be proved does not affect this.

The error in question is on p. 108,* where the number of syzygies of degree 5 (ground-syzygies) is said to be finite when they are really infinite, and consequently ground-forms and ground-syzygies coexist, for any quantic whose order is sufficiently great of degree 5 and any odd weight = or $>$ 15.

* I was aware after the discovery of the Falsity of the Postulate (which had been tacitly assumed as correct by almost all if not all previous writers), that the results, to one of which Mr. Hammond alludes, were open to question, and had contemplated making a remark to that effect in the 5th Section of my memoir, on Subinvariants.

The last few months will be a period forever memorable in the records of Mathematical Science, as one in which came to light the three great discoveries of a proof being possible of the impossibility of the Quadrature of the circle, the existence of an Assymptotic Value (by Mr. Hálphen) to the sum of the logarithms of the inferior primes to a given number, and the Falsity of the ordinarily assumed Postulate in the Theory of Invariants.

To prove this the l. g. f. (correctly deduced) is

$$\frac{-x^7}{(2)(4)} + \frac{x^{15}}{(2)(3)(4)(5)}.$$

If now Q_{2m} denote the quadrinvariant of the $2m$-ic and C_{2m+1} the cubic protomorph of weight $2m+1$, the residue of $(C_{2m+1}Q_{2p} - Q_{2m}C_{2p+1}) = 0$, and there are ground-syzygies of degree 5 and any odd weight $2m+2p+1$.

The weight being $2m+2p+1 = 2n+1$ suppose, m and p must be unequal parts of n, (for if they were equal $C_{2m+1}Q_{2p} = C_{2p+1}Q_{2m}$ identically and there would be no syzygy), the solutions from $2n+1=7$ to $2n+1=15$, inclusive, are as follows:

$$\left|\begin{matrix} n=3 \\ m=1 \\ p=2 \end{matrix}\right| \text{1 solution,} \quad \left|\begin{matrix} n=4 \\ m=1 \\ p=3 \end{matrix}\right| \text{1 solution,} \quad \left|\begin{matrix} n=5 & \\ m=1 & m=2 \\ p=4 & p=3 \end{matrix}\right| \text{2 solutions,}$$

$$\left|\begin{matrix} n=6 & \\ m=1 & m=2 \\ p=5 & p=4 \end{matrix}\right| \text{2 solutions,} \quad \left|\begin{matrix} n=7 & & \\ m=1 & m=2 & m=3 \\ p=6 & p=5 & p=4 \end{matrix}\right| \text{3 solutions.}$$

Thus the l. g. f. consists of a generating function for ground-forms, viz.: $\frac{x^{15}}{(2)(3)(4)(5)}$ and a generating function for syzygants $\frac{-x^7}{(2)(4)}$. It is not necessary here to complete the formal proof, and I will only remark in conclusion that what seems desirable is a general generating function for syzygants. †

† Another letter, dated March 14, has been received from Mr. Hammond, some interesting extracts from which, too late for insertion in this number, will probably appear in the following number of the *Circular*.

A letter to PROFESSOR SYLVESTER *from* M. ERNEST CESÁRO.

Monsieur:

Je viens de lire, dans les *Comptes Rendus* de l'Académie des Sciences de Paris, (12 Février, 1883), une de vos communications, sur la *probabilité que deux nombres entiers, pris au hasard, soient premiers entre eux.** Permettez-moi de vous dire que j'ai présenté, il y a près d' un an, à la *Société des Sciences de Liége*, un Mémoire d' *Arithmétique élémentaire*, dans lequel j'ai donné

$$\frac{6}{(\pi\delta)^2},$$

comme valeur de la probabilité que deux nombres entiers, *pris au hasard, admettent δ pour plus grand commun diviseur.*

Mon droit à la priorité se trouve, d'ailleurs, parfaitement établi par le fait que le théorème dont il s' agit, correspondant au cas de $\delta = 1$, a été publié par la *Mathesis*, en 1881. (*Question* 75).

Mes Notes sur l'Arithmétique élémentaire sont sur le point d'être livrées à la publicité. J' espère que vous voudrez me faire l' honneur de leur accorder votre bienveillante attention. Vous reconnaîtrez qu' elles renferment une méthode de calcul, générale, *élémentaire*, susceptible d' extension, et permettant, en particulier, de trouver beaucoup de propositions, dans le genre de celle, dont vous vous êtes occupé. En voici quelques-unes:

I.—*La probabilit équ' un nombre entier, pris au hasard, soit composé d' un nombre* impair *de facteurs premiers*, égaux ou inégaux, *est*

$$\frac{1}{2} - \frac{3}{\pi^2} = 0{,}1961.$$

II.—*Lorsqu' on divise un nombre n, par un nombre plus petit, pris au hasard, la probabilité que le rapport du reste au diviseur soit compris entre* $\frac{1}{4}$ *et* $\frac{3}{4}$ *tend vers*

$$\pi - \frac{8}{3} = 0{,}4749,$$

lorsque n augmente indéfiniment.

III.—1°. *La probabilité qu' un nombre entier, pris au hasard, soit le produit d' un nombre* impair *de facteurs premiers, inégaux, est*

$$\frac{3}{\pi^2} + \frac{18}{\pi^4} = 0{,}4888.$$

2°. *La probabilité qu' un nombre entier, pris au hasard, soit le produit d' un nombre* pair *de facteurs premiers,* inégaux, *est*

$$\frac{3}{\pi^2} - \frac{18}{\pi^4} = 0{,}1191,$$

IV.—*La probabilité qu' un nombre entier, pris au hasard, admette des diviseurs* carrés, *autres que l' unité, est*

$$1 - \frac{6}{\pi^2} = 0{,}3921.$$

V.—*a et b étant deux nombres entiers,* donnés, *premiers entre eux, et c un nombre entier,* pris au hasard, *soit P_r la probabilité que le nombre des solutions* entières, non négatives, *de l' équation*

$$ax + by = c,$$

excède, de r, le plus grand nombre entier contenu dans $\frac{c}{ab}$. *On a:*

$$\left.\begin{aligned} P_0 &= \frac{1}{2}\left(1-\frac{1}{a}\right)\left(1-\frac{1}{b}\right) \\ P_1 &= \frac{1}{2}\left(1+\frac{1}{a}\right)\left(1+\frac{1}{b}\right) - \frac{1}{ab} \end{aligned}\right\} P_0 + P_1 = 1.$$

VI.—*La probabilité que le plus grand nombre entier, contenu dans une quantité commensurable, positive, prise au hasard, soit un nombre* impair, *est*

$$\frac{1}{2}l2 = 0{,}3466,$$

. . . J' ai trouvé, en outre, que:

La différence entre une quantité commensurable, positive, et le plus grand nombre entier qu' elle renferme, est égale, en moyenne, à

$$\frac{3}{\ } - \frac{c}{\ } = 0{,}4614.*$$

Vous trouverez, dans mon Mémoire, une foule de propositions analogues.

Quant à la valeur asymptotique de votre fonction T, ou *somme-totient*, elle a été donnée, la première fois, par l' immortel Dirichlet. La question a été reprise, en 1873, par M. Mertens, dans le *Journal de Crelle;* en 1881, par M. Perott, dans le *Bulletin de Darboux*, et par moi. . . .

ERNEST CESÁRO,
Élève-Ingénieur de l'École des Mines de Liége,
(*Belgique*).

LIÉGE, 3 *Mars*, 1883.

* The denominators left blank are illegible in the MS.

* M. Cesáro refers to a paper bearing the title "On the number of unequal Vulgar Fractions expressible by integers not exceeding a given number;" the question of probability of relative-primeness is introduced by way of corollary only. J. J. S.

Extracts of a letter to PROFESSOR SYLVESTER *from* PROFESSOR CAYLEY.

Cambridge, January 15, 1883.—Hammond's result in disproof of the fundamental Postulate is very interesting—and it comes out so very simply. I suppose you have verified it—but if not, for the deg-order in question or deg-weight 5–11, the number of terms is 30, and deg-weight 5–10 number is 26, 30 — 26 = 4; and there are in fact 4 composite seminvariants; but between 3 of them there is a syzygy. In fact 2 of the composites are

$$\left|\begin{matrix} ae & +1 \\ bd & -4 \\ cf & +3 \end{matrix}\right| \times \left|\begin{matrix} a^2h & +1 \\ abg & -7 \\ cf & +9 \\ de & -5 \\ a^0b^2f & +12 \\ bce & -30 \\ bd^2 & +20 \end{matrix}\right| \times \left|\begin{matrix} ag & +1 \\ bf & -6 \\ ce & +15 \\ d^2 & -10 \end{matrix}\right| \times \left|\begin{matrix} a^2f & +1 \\ abe & -5 \\ acd & +2 \\ b^2d & +8 \\ bc^2 & -6 \end{matrix}\right|,$$

and clearly the terms without a are equal, hence the difference of the two composites divides by a, or it is $= a$ into a seminvariant of the deg-weight 4–11, viz., this is $= \frac{a^2eh+1}{a^2fg-1}$. I have not yet calculated the new irreducible seminvariant 5–11, but there would not be much difficulty in doing so.

But what becomes now of the general theory—how can we by means of it arrive at a limit to the number of irreducible covariants—or be sure that an irreducible covariant may not crop out at any place in the development of the N. G. F.? It is a most interesting question. . . .

I have been working at two particular questions which have interested me: 1°. The automorphic transformation of the binary cubic $(a, b, c, d \between x, y)^3$, *i. e.*, to satisfy $(a, b, c, d \between \alpha x + \beta y, \gamma x + \delta y)^3 = (a, b, c, d \between x, y)^3$. This is in effect given in Serret's Algebra, and the solution is wonderfully simple. Write $A, B, C = ac - b^2, ad - bc, bd - c^2, \lambda = \sqrt{-\frac{1}{3}}$, Ω the discriminant $a^2d^2 + \&c.$, then the values are

$$a = \frac{-\lambda\sqrt{\Omega} + B}{2\lambda\sqrt{\Omega}}, \beta = \frac{2C}{2\lambda\sqrt{\Omega}}, \gamma = \frac{-2A}{2\lambda\sqrt{\Omega}}, \delta = \frac{-\lambda\sqrt{\Omega} - B}{2\lambda\sqrt{\Omega}},$$

giving $a\delta - \beta\gamma = 1$ and $a + \delta = -1$, whence $a^2 + \delta^2 + a\delta + \beta\gamma = 0$, the condition for $\frac{ax+\beta}{\gamma x+\delta}$ periodic of the third order $\phi^3 x = x$. There is a good deal that is pretty in the working out.

2°. Riemann's theory of the bitangents of a plane quartic—see my addition at end of Salmon's H. P. C.—but a slight change of notation gives an additional symmetry to the solution; take $a_1, b_1, c_1, a_2, b_2, c_2, a_3, b_3, c_3$, arbitrary $f_1 = \frac{1}{a_1}$, &c., then the first three of the following four equations determine ξ, η, ζ as linear functions of x, y, z, and it is possible to determine and that in one way only a_4, b_4, c_4, and f_4, g_4, h_4, ($f_4 = \frac{1}{a_4}$, &c.) so as to satisfy the fourth equation

$$\begin{aligned} a_1x_1 + b_1y_1 + c_1z_1 + f_1\xi_1 + g_1\eta_1 + h_1\zeta &= 0, \\ a_2x_2 + b_2y_2 + c_2z_2 + f_2\xi_2 + g_2\eta_2 + h_2\zeta &= 0, \\ a_3x_3 + b_3y_3 + c_3z_3 + f_3\xi_3 + g_3\eta_3 + h_3\zeta &= 0, \\ a_4x_4 + b_4y_4 + c_4z_4 + f_4\xi_4 + g_4\eta_4 + h_4\zeta &= 0, \end{aligned}$$

and this being so, the equations of all the 28 bitangents of the curve

$$\sqrt{x\xi} + \sqrt{y\eta} + \sqrt{z\zeta} = 0,$$

can be expressed very simply in terms of $x, y, z, \xi, \eta, \zeta$, and the constants.

In consequence of the change it appears that six of the bitangents can be expressed each of them in a double four, viz., the two equations

$$\frac{x}{b_1c_1 - b_2c_2} + \frac{y}{c_1a_1 - c_2a_2} + \frac{z}{a_1b_1 - a_2b_2} = 0,$$

and

$$\frac{\xi}{g_3h_3 - g_4h_4} + \frac{\eta}{h_3f_3 - h_4f_4} + \frac{\zeta}{f_3g_3 - f_4g_4} = 0,$$

represent one and the same double tangent (in fact we get each of these equations, and so in all $22 + 6 + 6, = 34$, 6 double tangents too many, if the two were not identical), but the *a posteriori* verification of the identity of the two equations is not by any means easy.

Since this writing the idea flashed across me that the *same formulae* apply to the 16-nodal quartic surface, viz., if $x, y, z, \xi, \eta, \zeta$, are linear functions of four coordinates (of course these may be x, y, z, ξ) such that identically

$$\begin{aligned} x + y + z + \xi + \eta + \zeta + &= 0, \\ ax + by + cz + f\xi + g\eta + h\zeta &= 0, \end{aligned} \qquad af = bg = ch = 1.$$

then the quartic surface $\sqrt{x\xi} + \sqrt{y\eta} + \sqrt{z\zeta} = 0$, has the 16 singular tangent planes

$$\begin{array}{lll} x=0,\ y=0,\ z=0,\ \xi=0,\ \eta=0,\ \zeta=0, & & \\ x+y+z=0, & ax+by+cz=0, & \frac{x}{1-bc} + \frac{y}{1-ca} + \frac{z}{1-ab} = 0, \\ \xi+y+z=0, & f\xi+by+cz=0, & \\ x+\eta+z=0, & ax+g\eta+cz=0, & \frac{\xi}{1-gh} + \frac{\eta}{1-hf} + \frac{\zeta}{1-fg} = 0, \\ x+y+\zeta=0, & ax+by+h\zeta=0, & \end{array}$$

i. e., it is a 16-nodal surface. I have identified the form with one which I gave some time ago in the *Proc. L. M. S.*

I have just received No. 20 of the *J. H. Circular*: . . . "infinity" or "pole" is the French expression for your infinity-root—a word which occurred to me instead of the "essential singular point" of Weierstrass, *i. e.*, a non-algebraical infinity [such as $x = 0$ for $\log x$] is "chasm"—a function in general has thus roots, poles, and chasms.

[*Extract from a letter of* Professor Cayley *to* Dr. Franklin, *read at the meeting of the University Mathematical Society, February 21, 1883*].

It is I think noticeable that your theory* in connexion with the product $\overline{1-x}\ \overline{1-x^2}\ \overline{1-x^3}$ . . . *does something more* than group the partitions into pairs—in addition to the existing division $E + O$ of the partitions into even and odd, it establishes a new division $I + D$ of the same partitions into increasible and decreasible. There is thus a fourfold division

$$\frac{EI \mid OI}{ED \mid OD}.$$

For instance, if $N = 10$, the arrangement is

$$\frac{8+2,\ 7+3,\ 6+4 \mid 10,\ 5+3+2}{9+1,\ 4+3+2+1 \mid 7+2+1,\ 6+3+1,\ 5+4+1},$$

where the EI and OD each taken in order pair with each other, and similarly the OI and ED.

Of course for the exceptional numbers $N = 1, 2, 5, 7, 12, 15$, &c., there is just one partition which is neither I nor D; and according as it is O or E we have in the product a coefficient -1 or $+1$.

* *Comptes Rendus*, XCII, p. 448, 1880.

A Note from Professor Sylvester.

March 30, 1883.

My attention has been called to an appearance of contradiction between an erratum which I inserted on page 46 of the *Circulars* and a remark of mine in a previous number (*No.* 15, *May*, 1882). I think the seeming discrepancy will disappear if the point I desire to make is duly apprehended. I wished (as I still wish) it to be understood that it is Mr. Peirce's statement and not mine that the "forms" in question can be derived from his Logic of Relatives. I certainly know what he has told me and should attach implicit credit to any statement emanating from him, but have not the knowledge which would come from having myself found in his Logic of Relatives the forms referred to: as previously stated I have not read his Logic of Relatives and am not acquainted with its contents.

J. J. S.

A Communication from Mr. Peirce.

Readers of Professor Sylvester's communication entitled *Erratum* in the last number of these Circulars have perhaps inferred that my conduct in the matter there referred to had been in fault. Professor Sylvester's *Erratum* relates to his "Word upon Nonions," printed in the *Johns Hopkins University Circulars No.* 17, *p.* 242. In that article appears this sentence: "These forms [*i. e.* a certain group of nine Forms belonging to the algebra of Nonions] can be derived from an algebra given by Mr. Charles S. Peirce, (*Logic of Relatives*, 1870)." The object of Professor Sylvester's "*Erratum*" would seem to be to say that this sentence was inserted by me in his proof-sheet without his knowledge or authority on the occasion of the proof being submitted to me to supply a reference, and to repudiate the sentence, because he "knows nothing whatever" of the fact stated.

But I think this view of Professor Sylvester's meaning is refuted by simply citing the following testimony of Professor Sylvester himself, printed in the *Johns Hopkins University Circulars*, *No.* 15, *p.* 203.

"Mr. Sylvester mentioned . . . that . . . he had come upon a system of Nonions, the exact analogues of the Hamiltonian Quaternions . . . Mr. Charles S. Peirce, it should be stated, had to the certain knowledge of Mr. Sylvester arrived at the same result many years ago in connection with his theory of the *logic of relatives*; but whether the result had been published by Mr. Peirce, he was unable to say."

This being so, I think that on the occasion of Professor Sylvester's publishing these forms I was entitled to some mention, if I had already published them, and *a fortiori* if I had not. When the proof-sheet was put into my hands, the request made to me, by an oral message, was not simply to supply a reference but to correct a statement relating to my work in the body of the text. And I had no reason to suppose that having thus submitted his text to me, Professor Sylvester would omit to look at his proof sheet after it left my hands to see whether or not he approved of such alteration as I might have proposed. At any rate, when from these causes Professor Sylvester's "Word upon Nonions" had been published with the above statement concerning me, would it have been too much to expect that he should take the trouble to refer to my memoir in order to see whether the statement was not after all true, before publicly protesting against it?

I will now explain what the system of Nonions consists in and how I have been concerned with it.

The calculus of Quaternions, one of the greatest of all mathematical discoveries, is a certain system of algebra applied to geometry. A quaternion is a four-dimensional quantity; that is to say, its value cannot be precisely expressed without the use of a set of four numbers. It is much as if a geographical position should be expressed by a single algebraical letter; the value of this letter could only be defined by the use of two numbers, say the Latitude and Longitude. There are various ways in which a quaternion may be conceived to be measured and various different sets of four numbers by which its value may be defined. Of all these modes, Hamilton, the author of the algebra, selected one as the standard. Namely, he conceived the general quaternion q to be put into the form

$$q = xi + yj + zk + w,$$

where x, y, z, w, are four ordinary numbers, while i, j, k, are peculiar units, subject to singular laws of multiplication. For $ij = -ji$, the order of the factors being material, as shown in this multiplication table, where the first factor is entered at the side, the second at the top, and the product is found in the body of the table.

	1	i	j	k
1	1	i	j	k
i	i	-1	k	$-j$
j	j	$-k$	-1	i
k	k	j	$-i$	-1

As long as x, y, z, and w in Hamilton's standard tetranomial form are confined to being *real* numbers, as he usually supposed them to be, no simpler or more advantageous form of conceiving the measurement of a quaternion can be found. But my father, Benjamin Peirce, made the profound, original, and pregnant discovery that when x, y, z, w are permitted to be imaginaries, there is another very different and preferable system of measurement of a quaternion. Namely, he showed that the general quaternion, q, can be put into the form

$$q = xi + yj + zk + wl,$$

where x, y, z, w, are real or imaginary numbers, while i, j, k, l, are peculiar units whose multiplication obeys this table.

	i	j	k	l
i	i	j	0	0
j	0	0	i	j
k	k	l	0	0
l	0	0	k	l

A quaternion does not cease to be a quaternion by being measured upon one system rather than another. Any quantity belonging to the algebra is a quaternion; the algebra itself is "quaternions." The usual formulae of the calculus have no reference to any tetranomial form, and such a form might even be dispensed with altogether.

While my father was making his investigations in multiple algebra I was, in my humble way, studying the logic of relatives and an algebraic notation for it; and in the ninth volume of the *Memoirs of the American Academy of Arts and Sciences*, appeared my first paper upon the subject. In this memoir, I was led, from logical considerations that are patent to those who read it, to endeavor to put the general expression of any linear associative algebra into a certain form; namely as a linear expression in certain units which I wrote thus:

$$\begin{matrix} (u_1 : u_1) & (u_1 : u_2) & (u_1 : u_3), \text{ etc.,} \\ (u_2 : u_1) & (u_2 : u_2) & (u_2 : u_3), \text{ etc.,} \\ (u_3 : u_1) & (u_3 : u_2) & (u_3 : u_3), \text{ etc.,} \\ \text{etc.} & \text{etc.} & \text{etc.} \end{matrix}$$

These forms, in their multiplication, follow these rules:

$$(u_a : u_b)(u_b : u_c) = (u_a : u_c) \qquad (u_a : u_b)(u_c : u_d) = 0.$$

I said, "I can assert, upon reasonable inductive evidence, that all such algebras can be interpreted on the principles of the present notation in the same way," and consequently can be put into this form. I afterwards published a proof of this. I added that this amounted to saying that "all such algebras are complications and modifications of the . . . Hamilton's quaternions." What I meant by this appears plainly in the memoir. It is that any algebra that can be put into the form proposed by me is thereby referred to an algebra of a certain class (afterwards named *quadrates* by Professor Clifford) which present so close an analogy with quaternions that they may all be considered as mere complications of that algebra. Of these algebras, I gave as an example, the multiplication table of that one which Professor Clifford afterward named *nonions*.* This is the passage: "For example, if we have three classes of individuals, u_1, u_2, u_3, which are related to one another in pairs, we may put

$$\begin{matrix} u_1 : u_1 = i & u_1 : u_2 = j & u_1 : u_3 = k \\ u_2 : u_1 = l & u_2 : u_2 = m & u_2 : n_3 = n \\ u_3 : u_1 = o & u_3 : u_2 = p & u_3 : u_3 = q \end{matrix}$$

and by (155) we get the multiplication table

	i	j	k	l	m	n	o	p	q"
i	i	j	k	0	0	0	0	0	0
j	0	0	0	i	j	k	0	0	0
k	0	0	0	0	0	0	i	j	k
l	l	m	n	0	0	0	0	0	0
m	0	0	0	l	m	n	0	0	0
n	0	0	0	0	0	0	l	m	n
o	o	p	q	0	0	0	0	0	0
p	0	0	0	o	p	q	0	0	0
q	0	0	0	0	0	0	o	p	q

It will be seen that the system of nonions is not a group but an algebra; that just as the word "quaternion" is not restricted to the three perpendicular vectors and unity, so a nonion is any quantity of this nine-fold algebra.

So much was published by me in 1870; and it then occurred either to my father or to me (probably in conversing together) that since this algebra was thus shown (through his form of quaternions) to be the strict analogue of quaternions, there ought to be a form of it analogous to Hamilton's standard tetranomial form of quaternions. That form, either he or I certainly found. I cannot remember, after so many years, which first looked for it; whichever did must have found it at once. I cannot tell what his method of search would have been, but I can show what my own must have been. The following course of reasoning was so obtrusive that I could not have missed it.

Hamilton's form of quaternions presents a group of four square-roots of unity. Are there, then, in nonions, nine independent cube-roots of unity, forming a group? Now, unity upon my system of notation was written thus:

$$(u_1 : u_1) + (u_2 : u_2) + (u_3 : u_3).$$

Two independent cube-roots of this suggest themselves at once, they are

$$(u_1 : u_2) + (u_2 : u_3) + (u_3 : u_1)$$
$$(u_3 : u_2) + (u_2 : u_1) + (u_1 : u_3).$$

In fact these are hinted at in my memoir, p. 53. Then, it must have immediately occurred to me, from the most familiar properties of the imaginary roots of unity, that instead of the coefficients

$$1, \quad 1, \quad 1,$$

I might substitute

$$1, \quad g, \quad g^2,$$

or

$$1, \quad g^2, \quad g,$$

where g is an imaginary cube-root of unity. The nine cube-roots of unity

*It would have been more accurately analogical, perhaps, to call it *novenions*.

thus obtained are obviously independent and obviously form a group. Thus the problem is solved by a method applicable to any other quadrate.

My father, with his strong partiality for my performances, talked a good deal about the algebra of nonions in general and these forms in particular; and they became rather widely known as mine. Yet it is clear that the only real merit in the discovery lay in my father's transformation of quaternions. In 1875, when I was in Germany, my father wrote to me that he was going to print a miscellaneous paper on multiple algebra and he wished to have it accompanied by a paper by me, giving an account of what I had found out. I wrote such a paper, and sent it to him; but somehow all but the first few pages of the manuscript were lost, a circumstance I never discovered till I saw the part that had reached him (and which he took for the whole) in print. I did not afterward publish the matter, because I did not attach much importance to it, and because I thought that too much had been made, already, of the very simple things I had done.

I here close the narrative. The priority of publication of the particular group referred to belongs to Professor Sylvester. But most readers will agree that he could not have desired to print it without making any allusion to my work, and that to say the group could be derived from my algebra was not too much.

C. S. Peirce.

A NOTE ON THE WORD "SOPHY" IN SHAKESPEARE'S TWELTH NIGHT.

Act II, sc. 5, 166: *Fabian.* I will not give my part of this sport for a pension of thousands to be paid from the *Sophy*.

Act III, sc. 4, 265: *Sir Toby.* They say he has been fencer to the *Sophy*.

These passages are well illustrated in a letter of a contemporary of Shakespeare, the Italian traveller, Pietro Della Valle.* The letter is dated Ispahan, March 17, 1617, less than a year after Shakespeare's death, and goes into much detail about the origin of the word "Sofi," which was a dynastic title, and hence disappeared with the extinction of the dynasty (vol. i, p. 464 of the Brighton ed. of 1843). Especially interesting is what Pietro has to say about Sir Robert Shirley, whose adventures in Persia had made the Sophy so familiar a name in England. The shah, he says, always wears a red cap, "like the other *quizilbasci*, or Turkoman soldiers," on certain solemnities. This is called *tag* or crown, and is the sign of belonging to the military and the nobility. This *tag* is sometimes conferred on foreigners who take service with the king, "just as an order of knighthood with us," but this happens seldom, and a well informed person told Pietro that he had seen it conferred only once in fifteen years. The bestowal of the *tag* is accompanied with great ceremonies, the king putting his own *tag* on the head of the person who is to receive the honor. And now we will let Pietro tell the Shirley story in his own sour-sweet way:

"In questo modo fu dato il *tag* a quel don Roberto Serley inglese, che gli anni passati venne in Roma ambasciador di questo re a papa Paolo, e adesso torna un' altra volta a tutti i principi della cristianità; ed ho inteso qui che don Roberto lo domandò: ma io a dire il vero, non solo non domanderei giammai tal cosa al re di Persia, ma mi dispiacerebbe sopra modo quando egli me l'offerisse; perchè non so come un cristiano possa lecitamente portar quell' insegna, che, insieme con l'onorevole della militar nobiltà, ha congiunto anche in sè non poco del superstizioso della falsa loro setta; onde, per rimediare a ciò, conforme io penso, don Roberto intendo che in cristianità soleva portarvi in cima una croce. Ma oltre di questo, io non tengo che un Franco debba ambire di portare un' insegna d' onore, che è comune a molte migliaia di schiavi e di soldati ordinari; però per chi avesse voglia di vivere in Persia, come forse deve avere il detto don Roberto, potrebbe passar per cosa, se non desiderabile, almeno onorata."

Pietro was not averse to personal display and he might after all have consented to adorn his head as, at an earlier period of his travels, he had contrived to adorn his heels. Being in Constantinople he found that it was the fashion to have boot-heels shod with miniature horseshoes, and so he had his boot-heels shod, not with iron but with silver, a bit of dandyism, which, as he remarks complacently (vol. i, 97) was sufficiently conspicuous, and very cheap — (che per essa cosa insolita e neppur dall' istesso principe usata, con poca spesa in ciò lo feci parere una galanteria assai riguardevole).

B. L. G.

*Pietro Della Valle, characterized by Gibbon (c. xxiv) as "an intelligent man, a gentleman and a scholar, but intolerably vain and prolix," was born in Rome, April 11, 1586, and died in the city of his birth, April 21, 1652. He was a great traveller, for his time, and out of the heap of garrulous detail much interesting matter might be sifted.

A letter has been received from Dr. C. S. Hastings, dated Callao, March 21, 1883. He had just arrived at Callao and expected to leave, March 22, on the U. S. steamer Hartford for the Caroline Islands, the point selected for the observation of the eclipse of May 6.

SIDNEY LANIER MEMORIAL FUND.

Mr. Lawrence Turnbull, treasurer of the committee of the Sidney Lanier Memorial Fund, makes the following report:

"The friends of the late Sidney Lanier collected the sum of $6,250, as a tribute of affection and honor, to be used for the benefit of his family. Of this amount, a concert in Baltimore yielded $543.85, and a reading by Mr. Victor Rigueur yielded $56.50. A concert in Augusta, Ga., yielded $231.00. A concert in Macon, Ga., yielded $203.25. The remainder was contributed by individuals in sums varying from $5 to $500.

Baltimore	contributed	in all,	- - -	$4,555.35
New York	"	"	- - -	75.00
Philadelphia	"	"	- - -	545.00
Boston	"	"	- - -	350.00

and there were scattering subscriptions from Newport, New Orleans, Charleston, North Carolina, and Texas.

The Committee in charge, after consultation, placed the fund in the hands of one of their number as trustee, to be put at interest and disbursed for the benefit of Mr. Lanier's family in annual instalments.

For the Committee,

Baltimore, *Jan.* 1, 1883. L. Turnbull."

In this connection, it may be mentioned that by an additional contribution of some of the friends of Mr. Lanier, a memorial tablet has been placed in Hopkins Hall, bearing this inscription:

Aspiro dum Exspiro

SIDNEY LANIER

Poet

Lectured here on Literature, 1879–1881.

COMMEMORATION DAY.

The twenty-second day of February, 1883, was observed according to usage as the Commemoration Day of the University. The public exercises of the day were held in Hopkins Hall at four o'clock in the afternoon. Brief address were made by President Gilman, and by Professor C. A. Young, of Princeton College. An announcement of the establishment by the Trustees of eighteen Honorary Hopkins Scholarships was made by the Hon. George William Brown, Chairman of the Executive Committee.

The degree of Doctor of Philosophy was conferred upon two candidates, viz:

Kakichi Mitsukuri, (Ph. B., Yale College, 1879), who here pursued studies in Biology and has since been called to the Professorship of Zoölogy in the University of Tokio, Japan. His thesis on "The Structure and Significance of some Aberrant Forms of Lamellibranchiate Gills," has been published in the Monthly Journal of Microscopical Science.

Bernard F. O'Connor, (Bach. es Lettres, Université de France, 1874). His principal study was the Romance Languages, the subordinate, Latin. He submitted a thesis on "The Syntax of Ville-Hardouin."

The principal address by the Hon. S. Teackle Wallis was a discussion of the Johns Hopkins University in its relation to Baltimore. It has been printed in pamphlet form.

In the evening, there was a social assembly of the officers and students and their friends. The library and halls of the University were thrown open to a company of gentlemen and ladies, several hundred in number.

RECENT LECTURES AND ADDRESSES.

VII.

PROFESSOR JAMES A. HARRISON, of Washington and Lee University, gave, during the month of February, a course of ten lectures on Anglo-Saxon Poetry. A list of special topics and a bibliography specially prepared for the course are given on page 63 of *Circular* 21.

VIII.

DR. G. STANLEY HALL, Lecturer on Psychology, has just completed a course of eight lectures on the Principles and Methods of Intellectual Training.

Bibliography.

[Many of the books named in the list contain special bibliographies].

I. ALPHABETICAL ENCYCLOPEDIAS OF PEDAGOGY.

G. A. Lindner. Encyklopädisches Handbuch der Erziehungskunde (Vienna, 1882; now appearing in parts, and to constitute one large volume. Its matter freshly worked over and with references to the literature of each topic).
K. A. Schmid. Encyklopädie des gesammten Erziehungs und Unterrichtswesen. (Eleven large volumes. Stuttgart, 1858; second revised edition, 1880).

II. GENERAL WORKS ON PEDAGOGY.

F. G. Beneke. Erziehungs–und Unterrichts Lehre. (3d ed. Berlin, 1867. Two vols).
F. Dittes. Schule der Pädagogik.
J. F. Herbart. Pädagogische Schriften. (2d ed., Leipsic, 1882).
H. Kern. Grundriss der Pädagogik. (Berlin, 1878).
G. F. Pfisterer. Pädagogische Psychologie. (Güttersloh, 1880, pp. 340).
Jean Paul F. Richter. Levana. (tr. Boston, 1863).
Rosenkranz. Pedagogics as a System. (tr. St. Louis, 1873, Hegelian).
Roth. Gymnasial Pädagogik. (Stuttgart, 1879, pp. 470).
L. Strümpell. Psychologische Pädagogik. (Leipsic, 1880, pp. 368, Herbartian).
Schrader. Erziehungs-und Unterrichts Lehre. (Berlin, 1876. Two vols. The best for gymnasial teachers).
Waitz. Allgemeine Pädagogik. (Two vols., 1852).
Ziller. Allgemeine Pädagogik. (Leipsic, 1876, pp. 344).

III. DIDACTICS OF SPECIAL BRANCHES.

Bock. Der Volksschul-Unterricht.
Diesterweg. Wegweiser zur Bildung für deutsche Lehrer. (5th ed., Essen, 1874-7. Three vols.; very valuable).
Fitch. Lectures on Teaching. (London, 1880, pp. 436).
Rein, Pickle and Scheller. Theorie und Praxis der Volksschul-Unterricht. (Kassel, 1880. For the first three years of primary schools).

IV. HISTORY OF EDUCATION.

E. Brucklach. Wegweiser durch die Geschichte der Pädagogik. (Leipsic, 1869, pp. 149.)
C. Kehr. Geschichte der Methodik. (Gotha, 1879).
K. Quick. Educational Reformers. (Cincinnati, 1874).
K. Schmidt. Geschichte der Pädagogik. (3d ed., Köthen, 1875. Four vols).

IX.

MR. GEORGE W. CABLE, of New Orleans, gave, during the month of March, a course of six lectures on the Relations of Literature to Modern Society. At the close of his course, Mr. Cable, by special request, devoted an hour to reading passages from some of his sketches of Creole Life, which he illustrated with historical and descriptive comments.

X.

BERNARD F. O'CONNOR, late Fellow of the Johns Hopkins University, after taking his degree as Doctor of Philosophy, was invited to give six lectures on The Early French Chroniclers of the Crusades.

Special Dates and Subjects.

I. *Wednesday, March 28.* Introduction. Sketch of the causes and character of the Crusades. Their religious, political, and commercial aspect.

II. *Friday, March 30.* Chroniclers of the Crusades before Ville-Hardouin;—Latin and French: Guibert, Raymond of Agiles, Tudebod, Baldric, Fulcher of Chartres, Albert of Aix, William of Tyre, Saint Bernard.

III. *Wednesday, April 4.* Geoffroi de Ville-Hardouin. What is known of him as a man. His work: its historical and literary merit; its place in French literature; its influence on the language.

IV. *Friday, April 6.* Continuation of Ville-Hardouin's history by Henri de Valenciennes. Its author, its worth, style, and matter. Chroniclers of St. Louis. Letters of "Jean Pierre Sarrasins."

V. *Wednesday, April 11.* Jean de Joinville. As a man, as a historian, as a writer. His memoirs: their matter and form; literary beauties and influence.

VI. *Friday, April 13.* Death of Saint Louis. End of the Crusades. Comparison of the state of France before and after the Crusades, religious, political, social, commercial. Its literary progress. Summary.

Bibliography.

Bibliothèque de l'École des Chartres (P).
Bongars. Gesta Dei per Francos (P).
Brial. Rerum Gallicarum Scriptores (P).
Jean de Joinville. Memoirs—translated by Johnes (P).
Mabillon. Annales (P).
Martene. Thesaurus novus Anecdotorum (P).
Pertz. Monumenta Germaniae Historiae (P).
De Wailly. Ville-Hardouin's Conquest of Constantinople (P).
Aubertin. Hist. de la littérature du moyen age (P).
Bohn's Chronicles of the Crusades, (Extracts from an Arabian Ms.) p. 536, and seq. (P).
Guizot. Mémoires relatifs à l'histoire de France (P).
Mailly. L'esprit des Croisades.
Maimbourg. Histoire de Croisades (P).
Masson. Early Chronicles of Europe—France.
Gabriel Monod. Sources de l'Histoire Mérovingienne.
Petitot. Collection Complète des Mémoires relatifs à l'Histoire de France (P).
Röhricht. Beiträge zur Geschichte der Kreuzzüge (P).
Von Sybel. History and Literature of the Crusades (P).

The works marked (P) are in the Library of the Peabody Institute.

LIBRARY OF THE PEABODY INSTITUTE.

RECENT ACCESSIONS.

Various large and important books have recently been added to this library, of which the following deserve especial mention:—

In SCIENCE:

Aristotle. The Parts of Animals. Tr. by W. Ogle. 1882. r. 8°.
Clifford's Mathematical papers. 1882. r. 8°.
Cooke's British fresh-water Algae. 1882. 4°.
Day's Fishes of Great Britain. 1882. 4°.
Tryon's Structural and Systematic Conchology. 1882. 8°.
U. S. Signal Service, Professional papers. 1881. 4°.
Geikie's Text-book of Geology. 1882. r. 8°.
Fisher's Physics of the Earth's Crust. 1882. r. 8°.
Geology and Paleontology of India. 1881. 4°.

In ART and ARCHAEOLOGY:

Ebers' Egypt. 1881. Folio.
Bartolozzi and his Works. Ed. A. W. Tuer. 1882. Folio.
Hamerton's Graphic Arts. 1882. 4°.
Muntz's Raphael. 1882. 4°.
Perrot's and Chipiez's History of Egyptian Art. 1882. Folio.
Audsley's Polychromatic Decoration. 1882. Folio.
British Museum. Catalogue of Greek and Etruscan Vases. 1870. 8°.
Robinson's Eastern Carpets. 1882. Folio.

In PHILOLOGY, CLASSICAL LITERATURE, etc.:

Francisque Michel. The Scottish Language. 1882. Folio.
Virgil's Opera. Ed. A. Forbiger. 1872. r. 8°.
Ovid's Ibis. Ed. R. Ellis. 1881. r. 8°.
Hicks's Manual of Greek Historical Inscriptions. 1882. 8°.
Krapf's Dictionary of the Suahili Language. 1882. r. 8°.
Wollaston's English-Persian Dictionary. 1882. 4°.
British Museum, Catalogue of Ancient Manuscripts in the–. 1881. Folio.

In other departments may be mentioned:

Ashton's Social Life in the Reign of Queen Anne. 1882. 2 v., 8°.
Burton's Life of Camoens. 1881. 2 v., 8°.
Bunbury's History of Ancient Geography. 1881. 2 v., r. 8°.
Census of Ireland. 1881. 4 v., Folio.
Conway's Travels in South Kensington. 1882. r. 8°.
Craik's Life of Dean Swift. 1882. r. 8°.
Floyer's Unexplored Balūchistan. 1882. r. 8°.
Foly's Records of the English Province of the Society of Jesus. 1877-82. 7 v., 8°.
Hedges' History of Wallingford, Berks, England. 1881. 2 v., r. 8°.
Hunter's Statistical Account of Assam. 1879. 2 v, r. 8°.
Maskell's Monumenta Ritualia Ecclesiæ Anglicanæ. 1882. 2 v., r. 8°.
Miller, General J. Memoirs, in the Service of Peru. 1829. 2v., 8°.
O'Donovan's Merv Oasis. 1882. 2 v., r. 8°.
Rogers' History of Agriculture and Prices in England. 1881. 4 v., r. 8°.
Strachey's Finances of India. 1882. r. 8°.
Tupper's Punjab Customary Law. 1881. 3 v., 4°.
Wicquefort's, The Ambassador and his Functions. 1716. Folio.
Williams, H. M. State of Manners and Opinions in the (first) French Republic. 1801. 2 v., 8°.
Wyllie's External Policy of India. 1875. r. 8°.
Brain; a Journal of Neurology. 1879-83.

Numerous large works containing maps and plates illustrative of the wars of the time of Napoleon have also recently been added to the Library. Among them:—

Abercromby's Journal of the Forces . . . in the Mediterranean and Egypt, in 1800. 1802. Folio.
Brenton's Naval History of Great Britain. 1837 2 v., 8°.
Georgel's Mémoires pour servir à l'histoire des événements de la fin du dix-huitième siècle. 1817. 3 v., 8°.
Miot de Melitot's Memoirs. Ed. by Gen. Fleischmann. 1881. 2v., r. 8°.
Moore's Campaign of the British Army in Spain. 1809. 4°.
Rocca's Memoirs of the War of the French in Spain. 1815. 8°.
Treuenfeld's Die Tage von Ligny und Belle-Alliance. 1880. r. 8°.
Wilson's Character of the Russian Army . . . , and Sketch of the Campaigns in Poland in 1806-7. 1810. 4°.
Wyld's Memoir of the War in the Spanish Peninsula. 1841. 4°., with a folio Atlas of Maps, very elaborate, and carefully executed.

P. R. UHLER, *Librarian.*

ENUMERATION OF CLASSES, SECOND HALF-YEAR, 1882-3.

Mathematics. (28 Students).

Classes meet in Room 16.

Theory of Partitions: PROFESSOR SYLVESTER. Twice weekly, Tuesday and Friday, 4 P. M. (10).

Barnes. Bissing. Collins, J. V. Craig. Davis. Durfee. Ely, G. S. Franklin. Hathaway. Story.

Analytic Geometry: *Advanced Course:* DR. STORY. Twice weekly, Tuesday and Friday, 10 A. M. (4).

Bissing. Craig. Davis. Hathaway.

Quaternions: DR. STORY. Three times weekly, Tuesday, Thursday, and Friday, 9 A. M. (4).

Barnes. Collins, J. V. Faerber. Schuermann.

Conic Sections: DR. STORY. Three times weekly, Monday, Wednesday, and Thursday, 1 P. M. (9).

Artz. Crum. DeWitt. Faerber. Gilbert. Howe. Lyons. Nixon. Taber.

Partial Differential Equations: DR. CRAIG. Twice weekly, Monday and Thursday, 10 A. M. (2).

Collins, J. V. Schuermann.

Elliptic and Theta Functions: DR. CRAIG. Three times weekly, Tuesday, Wednesday, and Friday, 11 A. M. (9).

Barnes. Bissing. Collins, J. V. Davis. Durfee. Ely, G. S. Hathaway. Schuermann. Story.

Hydrodynamics: DR. CRAIG. Three times weekly, Monday, Tuesday, and Thursday, 12 M. (5).

Barnes. Brace. Kimball. Reid. Schuermann.

Theory of Equations: DR. FRANKLIN. Three times weekly, Monday, Wednesday, and Friday, 11 A. M. (3).

Faerber. Howe. Nixon.

Total Differential Equations: DR. FRANKLIN. Three times weekly, Tuesday, Thursday, and Friday, 10 A. M. (9).

Duncan. Faerber. Howe. Kimball. Morrill. Nixon. Perkins, C. A. Perkins, W. H. Veblen.

Statics: DR. FRANKLIN. Three times weekly, Monday, Tuesday, and Thursday, 12 M. (5).

Crum. Hathaway. Howe. Nixon. Veblen.

Physics. (39 Students).

Classes meet in Rooms 3, 4, 7, 8.

Electricity and Magnetism: PROFESSOR ROWLAND. Four times weekly, Monday, Tuesday, Wednesday, and Friday, 3 P. M. (9).

Brace. Duncan. Goodnow. Kimball. Liebig, G. A. Morrill. Perkins, C. A. Reid. Schuermann.

Laboratory Work: PROFESSOR ROWLAND. Daily. (8 advanced students).

Brace. Goodnow. Kimball. Koyl. Liebig, G. A. Morrill. Perkins, C. A. Reid.

Major Course: DR. HASTINGS. Lecture, weekly, Thursday, 3.30 P. M.; Laboratory work, daily, especially Wednesday. (14).

Brace. Collins. J. V. Davis. Day, D. T. Duncan. Durfee. Ely, G. S. Hall, C. C. Howe. Kimball. Morrill. Reid. Schubart. Schuermann.

General Physics: *Minor Course:* DR. HASTINGS. Daily, 10 A. M. (21).

Artz. Bayley. Boston. Campbell. Carey. Carroll. Crum. Dewitt. Fels. Gilbert. Hillyer. Hinkley. Howard. Huggins. Johnston, R. C. Lodge. Orndorff. Pleasants. Scott. Williams, H. W. Wilson.

During the absence of Dr. Hastings, this course has been conducted by Mr. J. Rendel Harris.

Laboratory Work: (*Class in General Physics*)*:* DR. HASTINGS and MR. REID. (17).

Artz. Bayley. Boston. Campbell. Carey. Carroll. Crum. DeWitt. Fels. Gilbert. Hillyer. Hinkley. Howard. Johnston, R. C. Orndorff. Pleasants. Scott.

Biology. (27 Students).

Classes meet in the Biological Laboratory.

Laboratory Work: PROFESSOR MARTIN and DR. SEDGWICK. Daily, 9 A. M. to 5 P. M. (25).

Beyer. Cattell. Colton. Conn. Councilman. Donaldson. F. Donaldson, H. H. Duggan. Ely, J. S. Friedenwald. Howell. Jenkins. Kemp. Lee. Lord, J. W. Mackenzie. Mills. Mussey. Nachtrieb. Osborn. Stevens. Stratton. Thomas, H. M. Tuttle. Wilson.

Animal Physiology: PROFESSOR MARTIN. Four times weekly, Monday, Tuesday, Thursday, and Friday, 10 A. M. (18).

Beyer. Cattell. Conn. Dewey. Donaldson, H. H. Ely, J. S. Howell. Jenkins. Johnson, R. W. Lee. Mills. Mussey. Nachtrieb. Osborn. Stevens. Stratton. Thomas, H. M. Tuttle.

General Biology: DR. SEDGWICK. Three times weekly, Monday, Wednesday, and Friday, 11 A. M. (7).

Friedenwald. Jenkins. Kemp. Lord, J. W. Mussey. Nachtrieb. Wilson.

Osteology: DR. BROOKS. Twice weekly, Tuesday and Thursday, 11 A. M. (6).

Friedenwald. Jenkins. Lord, J. W. Mussey. Nachtrieb. Wilson.

Mammalian Anatomy: DR. BROOKS. Twice weekly, Monday and Thursday, 12 M. (6).

Conn. Jenkins. Nachtrieb. Osborn. Stratton. Thomas, H. M

Chemistry. (43 Students).

Classes meet in the Chemical Laboratory.

Laboratory Work: PROFESSOR REMSEN, DR. MORSE, and DR. COALE. Daily. (40).

Baker. Bayley. Boston. Campbell. Collins, A. T. Councilman. Cromwell. Cumming. Day, D. T. Day, W. C. Duggan. Ely, J. S. Friedenwald. Gittings. Gordon. Hillyer. Howell. Huggins. Johnston, R. C. Keiser. Kemp. Laessig. Liebig, R. A. Lord, J. W. Mills. Mussey. Orndorff. Page. Palmer. Perkins, C. A. Piggot. Pund. Schubart. Smith. Stokes, H. N. Stratton. Wiegand. Wilkens. Wilson. Yonce.

Chemistry of Carbon Compounds: PROFESSOR REMSEN. Daily, 9 A. M. (16).

Applegarth. Bayley. Collins, A. T. Duggan. Ely, J. S. Friedenwald. Hillyer. Howell. Keiser. Kemp. Liebig, R. A. Lord, J. W. Orndorff. Palmer. Pund. Wiegand.

General Chemistry: DR. MORSE. Daily, 9 A. M. (17).

Baker.	Duncan.	Laessig.	Schubart.
Boston.	Gittings.	Mussey.	Smith.
Campbell.	Huggins.	Page.	Wilkens.
Cromwell.	Johnston, R. C.	Perkins, C. A.	Wilson.
Cumming.			

Mineralogy: DR. WILLIAMS. Twice weekly, Friday, 2–5 P. M., Saturday, 9 A. M. to 12 M. (13).

Bayley.	Duggan.	Liebig, R. A.	Pund.
Collins, A. T.	Hillyer.	Orndorff.	Robertson.
Day, D. T.	Keiser.	Palmer.	Wiegand.
Day, W. C.			

Greek. (41 Students).

Classes meet in 181 Howard Street.

Seminary: PROFESSOR GILDERSLEEVE. Twice weekly, Monday and Wednesday, 12 M. (9).

Alexander.	Fleming.	Miller, C. W. E.	Short.
Arnolt.	Harding.	Murray, J. S.	Wiggins.
Emerson.			

Pindar: PROFESSOR GILDERSLEEVE. Weekly, Thursday, 12 M. (9).

Alexander.	Fleming.	Miller, C. W. E.	Short.
Arnolt.	Harding.	Murray, J. S.	Wiggins.
Emerson.			

Greek Syntax: PROFESSOR GILDERSLEEVE. Twice weekly, Tuesday and Friday, 10 A. M. (12).

Alexander.	Cole.	Harding.	Murray, J. S.
Anderson.	Emerson.	Holstad.	Wiggins.
Arnolt.	Fleming.	Miller, C. W. E.	Zweizig.

Comparative Grammar of Greek: DR. BLOOMFIELD. Weekly, Thursday, 4 P. M. (9).

Alexander.	Emerson.	Short.	Tolman.
Arnolt.	Jagemann.	Spieker.	Warren, H. C.
Bright.			

Aeschylus: *Prometheus;* ***Euripides:*** *Medea:* PROFESSOR MORRIS. Four times weekly, Tuesday, Wednesday, Thursday, and Friday, 9 A. M. (9).

Cole.	Holstad.	McDaniel.	Stout.
Glenn, J.	Lodge.	Murray, J. S.	Walz.
Glenn, W. L.			

Homer: *Iliad*, XVI–XIX: DR. SPIEKER. Four times weekly, Tuesday, Wednesday, Thursday, and Friday, 11 A. M. (14).

Bevan.	Egge.	Loane.	Rich.
Buckler.	Fink.	McLane.	Roberts.
Crutchfield.	Gates.	Merryman.	Wilkens.
Cumming.	Howard.		

New Testament Greek: MR. HARRIS. Twice weekly, Monday and Wednesday, 1 P. M. (12).

Anderson.	Cole.	Lodge.	Sieber.
Arnolt.	Cumming.	McDaniel.	Walz.
Beadenkopf.	Gates.	Rich.	Webb.

Prose Composition:

Class A. PROFESSOR MORRIS. Weekly, Monday, 9 A. M. (6).

Glenn, J.	Lodge.	Stout.	Walz.
Glenn, W. L.	McDaniel.		

Class B. DR. SPIEKER. Weekly, Monday, 11 A. M. (14).

Bevan.	Egge.	Loane.	Rich.
Buckler.	Fink.	McLane.	Roberts.
Crutchfield.	Gates.	Merryman.	Wilkens.
Cumming.	Howard.		

Latin. (38 Students).

Classes meet in 181 Howard Street.

Seminary: Cicero: DR. WARREN. Twice weekly, Tuesday and Friday, 11 A. M. (10).

Fleming.	Miller. C. W. E.	Pease.	Stout.
Harding.	Murray, J. S,	Short.	Zweizig.
Holstad.	O'Connor.		

Historical Latin Grammar: DR. WARREN. Weekly, Saturday, 9 A. M. (22).

Anderson.	Fleming.	Lodge.	Pease.
Arnolt.	Glenn, J.	Lord, J. D.	Short.
Canfield.	Glenn, W. L.	Miller, C. W. E.	Stout.
Egge.	Harding.	Murray, J. S.	Walz.
Evenson.	Hinkley.	O'Connor.	Zweizig.
Fels.	Holstad.		

Plautus; Terence: DR. WARREN. Four times weekly, Tuesday, Wednesday, Thursday, and Friday, 12 M. (10).

Canfield.	Glenn, W. L.	Lodge.	Stout.
Carey.	Hinkley.	Lord, J. D.	Walz.
Glenn, J.	Holstad.		

Latin Poets: *Crowell's Selections:* PROFESSOR MORRIS. Four times weekly, Tuesday, Wednesday, Thursday, and Friday, 10 A. M. (5).

Glenn, W. L.	Rich.	Stout.	Wilkens.
Gregg.			

Horace: DR. SPIEKER. Four times weekly, Tuesday, Wednesday, Thursday, and Friday, 9 A. M. (11).

Bevan.	Fink.	Lyons.	Roberts.
Buckler.	Gates.	McLane.	Stokes, G. C.
Crutchfield.	Loane.	Pleasants.	

Prose Composition:

Class A. DR. WARREN. Weekly, Monday, 11 A. M. (7).

Canfield.	Glenn, W. L.	Lodge.	Walz.
Carey.	Hinkley.	Lord, J. D.	

Class B. PROFESSOR MORRIS. Weekly, Monday, 10 A. M. (5).

Glenn, J.	Rich.	Stout.	Wilkens.
Gregg.			

Class C. DR. SPIEKER. Weekly, Monday, 9 A. M. (11).

Bevan.	Egge.	Loane.	Pleasants.
Buckler.	Fink.	Lyons.	Roberts.
Crutchfield.	Gates.	McLane.	

Sanskrit. (5 Students). DR. BLOOMFIELD.

Classes meet in 181 Howard Street.

Rig-Veda: Twice weekly, Wednesday and Saturday, 10 A. M. (2).

Bright. Warren, H. C.

Kathāsaritsāgara: Weekly, Wednesday, 3 P. M. (2).

Spieker. Warren, H. C.

Comparative Grammar of Sanskrit: Weekly, Tuesday, 10 A. M. (3).

Bright. Spieker. Warren, H. C.

Elementary Sanskrit: Nala: Twice weekly, Tuesday and Friday, 4 P. M. (2).

Alexander. Murray, J. S.

Hebrew. (4 Students). DR. BLOOMFIELD. Twice weekly, Monday, 4 P. M., Friday, 3 P. M., 181 Howard Street.

Beadenkopf. Merryman. Sieber. Walz.

German. (43 Students).

Classes meet in 111 Monument Street.

(Advanced Course).

Gothic: DR. WOOD. Twice weekly, Monday, 11 A. M., Wednesday, 4 P. M. (4).

Arnolt. Evenson. Tolman. Wright.

Old High German: DR. BRIGHT. Twice weekly, Tuesday and Friday, 4 P. M. (1).

Jagemann.

(*Major Course*).

German Literature: *Lectures in German:* Dr. Wood. Alternate Saturdays, 10 A. M. (9).

Dorsey.	Glenn, J.	Johnston, R. C.	Steiner.
Egge.	Kemp.	Ryttenberg.	Stratton.
Evenson.			

Middle High German: Mr. Raddatz. Twice weekly, Tuesday and Friday, 3 P. M. (4).

Bissing.	Evenson.	Garthe.	Witzenbacher.

Stilübungen and Essays: Mr. Raddatz. Second Thursday of each month, 3 P. M. (9).

Bissing.	Evenson.	Johnston, R. C.	Sieber.
Dorsey.	Glenn, J.	Ryttenberg.	Steiner.
Egge.			

Goethe: *Faust:* Dr. Bright. Twice weekly, Tuesday and Friday, 11 A. M. (9).

Anderson.	Johnston, R. C.	Ryttenberg.	Stratton.
Dorsey.	Orndorff.	Steiner.	Williams, H. W.
Glenn, J.			

Lessing: *Hamburgische Dramaturgie:* Dr. Bright. Twice weekly, Monday and Thursday, 11 A. M. (11).

Anderson.	Johnston, R. C.	Pease.	Stratton.
Dorsey.	Murray, J. S.	Ryttenberg.	Williams, H. W.
Glenn, J.	Orndorff.	Steiner.	

Prose Composition: Mr. Raddatz. Weekly, Wednesday, 3 P. M. (14).

Dorsey.	Johnson, R. C.	Scott.	Tiffany.
Egge.	Loane.	Steiner.	Williams, H. W.
Evenson.	Orndorff.	Stratton.	Witzenbacher.
Glenn, J.	Ryttenberg.		

Syntax: Mr. Raddatz. Three times monthly, Thursdays, 3 P. M. (9).

Egge.	Ryttenberg.	Steiner.	Tiffany.
Glenn, J.	Scott.	Stratton.	Williams, H. W.
Orndorff.			

(*Minor Course*).

Literary: *Goethe's Prose*; *Egmont:* Dr. Wood. Twice weekly, Tuesday and Friday, 12 M. (19).

Applegarth.	Egge.	Lord, J. W.	Scott.
Artz.	Gates.	Miller, E. G.	Stokes, G. C.
Campbell.	Gilbert.	Perkins, W. H.	Tolman.
Carroll.	Harlan.	Rich.	Wright.
De Witt.	Loane.	Roberts.	

Historical: *Dahn's Urgeschichte der germ. und rom. Völker:* Dr. Wood. Twice weekly, Monday and Thursday, 12 M, (9).

Applegarth.	Loane.	Roberts.	Stokes, G. C.
Caldwell.	Perkins, W. H.	Scaife.	Yager.
Gates.			

Scientific: *Humboldt in Auswahl:* Dr. Bright. Twice weekly, Monday and Thursday, 12 M. (7).

Boston.	Carroll.	Gilbert.	Miller, E. G.
Campbell.	De Witt.	Lord, J. W.	

Prose Composition: Dr. Wood and Mr. Raddatz. Weekly, Wednesday, 12 M. (21).

Applegarth.	Egge.	Lord, J. W.	Scaife.
Artz.	Gates.	Miller, E. G.	Scott.
Caldwell.	Gilbert.	Perkins, W. H.	Stokes, G. C.
Campbell.	Harlan.	Rich.	Tolman.
Carroll.	Loane.	Roberts.	Wright.
De Witt.			

Romance Languages. (21 Students).

Classes meet in 111 West Monument Street.

Advanced Courses: (5 classes). *Provençal* (*Extracts*); *Portuguese* (*Os Lusiadas*); *Old French* (*Vie de Saint Alexis*); *Franco-Norman* (*Roman de Rou*); *Provençal Dialects* (*Lectures*): Mr. Elliott. Monday, Tuesday, and Thursday, 12 M; Wednesday, 10 A. M. to 12 M. (3).

Bright.	Jagemann.	O'Connor.

(*Major Course*).

Spanish: *Don Quijote:* Mr. Elliott. Twice weekly, Monday and Thursday, 11 A. M. (4).

Harlan.	Perkins, W. H.	Wilson.	Witzenbacher.

Old French: Mr. Marcou. Twice weekly, Tuesday and Wednesday, 11 A. M. (2).

Harlan.	Perkins, W. H.

French Literature: Mr. Marcou. Weekly, Friday, 11 A. M. (3).

Harlan.	Perkins, W. H.	Witzenbacher.

French: Minor Course:

Historical: *Fustel de Coulanges:* Mr. Marcou. Twice weekly, Tuesday and Thursday, 1 P. M. (7).

Canfield.	Kemp.	Penniman.	Wiegand.
Cromwell.	Lord, J. D.	Ryttenberg.	

Literary: *Victor Hugo:* Mr. Marcou. Twice weekly, Wednesday and Friday, 1 P. M. (6).

Canfield.	Kemp.	Penniman.	Ryttenberg.
Cromwell.	Lord, J. D.		

Scientific: *Elisée Reclus:* Mr. Marcou. Twice weekly, Wednesday and Friday, 12 M. (1).

Wiegand.

Grammar and Composition: Mr. Marcou. Weekly, Monday, 1 P. M. (8).

Canfield.	Kemp.	Penniman.	Ryttenberg.
Cromwell.	Lord, J. D.	Perkins, W. H.	Wiegand.

Conversation Class: M. Rabillon. Appointments are made with individual students, daily, 12 M. (8).

Egge.	Howe.	Steiner.	Witzenbacher.
Evenson.	Laessig.	Wilkens.	Wright.

English. (36 Students).

Classes meet in 111 Monument Street.

Anglo-Saxon I: *Sweet's Reader, etc.:* Dr. Wood. Twice weekly, Tuesday and Friday, 4 P. M. (6).

Arnolt.	Egge.	Tolman.	Wright.
Crum.	Evenson.		

Anglo-Saxon II: *Lectures, etc.:* Dr. Wood. Weekly, Thursday, 4 P. M. (7).

Cole.	Miller, E. G.	Stratton.	Wiegand.
Egge.	Steiner.	Sudduth.	

Early English: *Morris's Specimens, etc.:* Dr. Wood. Twice weekly, Wednesday and Thursday, 11 A. M. (6).

Arnolt.	Evenson.	Tolman.	Wright.
Egge.	Sudduth.		

Chaucer: Dr. Wood. Twice weekly, Monday, 4 P. M., Tuesday, 3 P. M. (10).

Arnolt.	Miller, E. G.	Sudduth.	Wiegand.
Egge.	Steiner.	Tolman.	Wright.
Evenson.	Stratton.		

Modern English: Dr. Browne. Twice weekly, Wednesday and Friday, 2 P. M. (29).

Anderson.	Cumming.	McCay.	Stratton.
Artz.	Egge.	McLane.	Shinn.
Bayley.	Gates.	Miller, E. G.	Sieber.
Bemis.	Glenn, W. L.	Patten.	Steiner.
Bevan.	Howard.	Pleasants.	Thomas, H. M.
Bissing.	Kemp.	Rich.	Wiegand.
Cromwell.	Loane.	Sewall.	Wilkens.
Crutchfield.			

History and Political Science. (64 Students).

Classes meet in 113 Monument Street, except a otherwise specified.

Seminary: DR. ADAMS. Weekly, Friday, 8 P. M. (27).

Bemis.	Gould.	Ramage.	Sollers.
Caldwell.	Hebden.	Rhodes.	Tiffany.
Dewey.	Ingle.	Robinson.	Wilhelm.
Ely, R. T.	Jameson.	Rose.	Williams, F. R.
Fels.	Johnson, J.	Scaife.	Wood, A.
Fisher.	Linthicum.	Sewall.	Yager.
Goodman.	Murray, D. M.	Shinn.	

Comparative Constitutional History: DR. ADAMS. Weekly, Saturday, 12 M., Peabody Institute. (16).

Bemis.	Fisher.	Ramage.	Wilhelm.
Caldwell.	Gould.	Scaife.	Williams, F. R.
Dewey.	Ingle.	Sewall.	Wood, A.
Fels.	Patten.	Shinn.	Yager.

Modern History: DR. ADAMS. Daily, 2 P. M. (18).

Applegarth.	Gregg.	Miller, E. G.	Swann.
Canfield.	Hinkley.	Penniman.	Walz.
Carey.	Lord, J. D.	Scaife.	Williams, H. W.
Dorsey.	Lyons.	Stokes, G. C.	Witzenbacher.
Fink.	McDaniel.		

Classical History: DR. JAMESON. Twice weekly, Tuesday and Thursday, 2 P. M. (17).

Artz.	Glenn, W. L.	McCay.	Ryttenberg.
Bayley.	Howard.	McLane.	Sewall.
Bevan.	Kemp.	Patten.	Steiner.
Cumming.	Loane.	Pleasants.	Wilkens.
Gates.			

Finance and Administration: DR. ELY. Three times weekly, Monday, Wednesday, and Friday, 4 P. M. (20).

Armstrong.	Gould.	Rhodes.	Tiffany.
Bemis.	Harlan.	Sewall.	Wilhelm.
Caldwell.	Ingle.	Shinn.	Williams, F. R.
Fels.	Patten.	Swann.	Wood, A.
Goodman.	Ramage.	Thomas, W. J.	Yager.

Historical Systems of Political Economy: DR. ELY. Daily, 9 A. M. (11).

Cromwell.	Patten.	Swann.	Witzenbacher.
Fels.	Sewall.	Thomas, W. J.	Yager.
McCay.	Shinn.	Williams, F. R.	

Logic. (7 Students).

MR. PEIRCE. Four times weekly, Tuesday and Thursday, 5 P. M., Wednesday and Friday, 9 A. M., 187 Howard Street.

Howard.	Merryman.	Perkins, W. H.	Williams, H. W.
Jastrow.	Penniman.	Taber.	

Psychology, etc. (21 Students).

Classes meet in 187 Howard Street.

Psychology: *Advanced Course:* DR. HALL. Four times weekly, Monday, Tuesday, Thursday, and Friday, 4 P. M. (12).

Beyer.	Dewey.*	Hartwell.*	Robinson.
Cattell.*	Fels.	Jastrow.*	Stevens.
Cole.	Fisher.	McDaniel.	Thomas, H. M.

* Engaged also in observation and experiment.

Psychology: *Elementary Course:* DR. HALL. Three times weekly, Monday, Wednesday, and Friday, 12 M. (10).

Friedenwald.	Merryman.	Sieber.	Swann.
Jastrow.	Penniman.	Steiner.	Tiffany.
Lyons.	Ryttenberg.		

History of Philosophy: MR. DEWEY. Twice weekly, Tuesday and Thursday, 12 M. (7).

Friedenwald.	Merryman.	Ryttenberg.	Swann.
Lyons.	Penniman.	Steiner.	

Elocution. (31).

MR. WOODWORTH. Appointments are made with individual students, daily, 10 A. M. to 1 P. M., Hopkins Hall.

Campbell.	Glenn, W. L.	Miller, E. G.	Sieber.
Canfield.	Harlan.	Pease.	Stokes, G. C.
Carroll.	Hinkley.	Penniman.	Stratton.
Cole.	Kemp.	Rich.	Tiffany.
Crutchfield.	Loane.	Roberts.	Tolman.
Cumming.	McCay.	Scaife.	Wiegand.
Dorsey.	McDaniel.	Sewall.	Williams, F. R.
Fels.	Merryman.	Shinn.	

Drawing. (8).

MR. NEWELL. Twice weekly, Monday and Friday, 3 P. M.

Beyer.	Johnston, R. C.	Nachtrieb.	Smith.
Jenkins.	Lee.	Osborn.	Thomas, H. M.

Physical Culture.

DR. HARTWELL. Weekly, Wednesday, 5 P. M. (Attendants on Lectures, 47).

Applegarth.	Fels.	McLane.	Roberts.
Artz.	Friedenwald.	Merrryman.	Scaife.
Bayley.	Gilbert.	Miller, E. G.	Sewall.
Boston.	Gittings.	Mussey.	Smith.
Campbell.	Glenn, W. L.	Orndorff.	Steiner.
Canfield.	Hinkley.	Patten.	Stratton.
Carey.	Howard.	Penniman.	Thomas, H. M.
Carroll.	Laessig.	Perkins, W. H.	Wiegand.
Cole.	Liebig, G. A.	Pleasants.	Wilkens.
Cromwell.	Loane.	Reid.	Williams, H. W.
De Witt.	Lodge.	Rich.	Witzenbacher.
Dorsey.	McDaniel.	Ryttenberg.	

Official Publications of the University.

I. An ANNUAL REPORT presented by the President to the Board of Trustees, reviewing the operations of the University during the past academic year. The Seventh Annual Report, issued November 11, 1882, will be sent on application.

II. The UNIVERSITY CIRCULARS, issued from time to time, giving current information as to the work here in progress or proposed.

III. A REGISTER, giving the list of officers, academic staff, and students, and containing detailed statements as to the regulations and work of the University. The Register for the current year will be issued about the first of June.

Announcements of proposed lectures, courses of instruction, etc., appear in the University Circulars, or are separately issued from time to time.

Appointments of Societies.

The University societies meet monthly during the academic year, as follows:

Scientific—First Wednesday, 8 p. m.
Philological—First Friday, 12 m.
Metaphysical—Second Tuesday, 8 p. m.
Historical and Political Science—Third Friday, 8 p. m.
Mathematical—Third Wednesday, 8 p. m.
Naturalists' Field Club—As announced.

Maryland Historical Society—Second Monday, 8 p. m.
Maryland Academy of Sciences—First and Third Monday, 8 p. m.

The UNIVERSITY DIRECTORY, Schedule of CONSULTATION HOURS, etc., etc., is printed on pages 19, 20, of *Circular* 19.

The University Circulars, Annual Report, and Register will be sent by mail for one dollar per annum. Price of Volume I. of University Circulars, with index, bound, three dollars.

PROCEEDINGS OF SOCIETIES.

Scientific Association.

February 7.—Forty-seventh regular meeting. Professor Sylvester in the chair. Thirty members present.

Papers read:

On the Action of Phosphorus on Moist Air, by I. REMSEN. (*Abstract on p.* 74).

On Pleomorphism in Penicilium, by J. R. DUGGAN. (*Abstract on p.* 50).

A Note on the Helmholtz-Koenig Controversy, by G. BISSING. (*Abstract on p.* 74).

March 7.—Forty-eighth regular meeting. Professor Remsen in the chair. Forty-three members present.

Papers read:

On some Recent Investigations upon what is called the "Nascent" State of Elements, by I. REMSEN.

On Progress in Spectrum Photography, by H. A. ROWLAND.

Note on the Anatomy of the Malar Bone, by E. M. HARTWELL. (*Abstract on p.* 74).

Radial and Bilateral Symmetry in Animals, by H. W. CONN. (*Abstract on p.* 73).

April 4.—Forty-ninth regular meeting. Professor Martin in the chair. Forty members present.

Papers read:

On Alternation of Generations in the Hydro-Medusae, by W. K. BROOKS. (*Abstract on p.* 73.

On Cilia in the Human Kidney, by A. H. TUTTLE.

Dr. Story exhibited a number of models of surfaces of the second order, recently purchased by the University.

Philological Association.

February 2.—Forty-fourth regular meeting. Professor Gildersleeve in the chair. Twenty-nine members present.

Papers read:

On Participial Periphrases in Attic Prose, by W. J. ALEXANDER. (*Abstract on p.* 66).

On the Second Mutation of Consonants in French, by H. C. G. JAGEMANN. (*Abstract on p.* 68).

On the General Theory of Greek Accentuation, by M. BLOOMFIELD. (*Abstract on p.* 66).

On the Normal Forms of the Pliny and Cicero Letters, by J. R. HARRIS. (*Abstract on p.* 66).

March 2.—Forty-fifth regular meeting. Professor Gildersleeve in the chair. Twenty-six members present.

Papers read:

On the Athenian Jurisdiction over the Allies, by C. D. MORRIS. (*Abstract on p.* 69).

On French Syntax as Affected by the Cultivation of Style, by P. B. MARCOU. (*Abstract on p.* 68).

On the so-called Dying Alexander of the Uffizi Gallery, by A. EMERSON. (*Abstract on p.* 68).

April 6.—Forty-sixth regular meeting. Professor Gildersleeve in the chair. Twenty-four members present.

Papers read:

On Functional Differences of the Past Participle in the Periphrastic Perfects of the Latin, Old and Modern French, by A. M. ELLIOTT.

On the Symmetrical Structure of the Pindaric Odes, by B. L. GILDERSLEEVE.

Introductory Note on the Stichometry of Euthalius, by J. R. HARRIS.

On the Probable Sanskrit Equivalent of φίλος, by M. BLOOMFIELD.

Historical and Political Science Association.

January 26.—Dr. H. B. Adams in the chair. Twenty-four persons present.

Papers read:

The English Parish in America, with illustrations from the original records of St. John's Parish, Harford and Baltimore Counties, Maryland, by H. B. ADAMS (*Abstract on p.* 75).

Review of Lenormant's "Beginnings of History," by H. W. CALDWELL. (*Printed in the American Literary Churchman, Baltimore, March*, 1883).

February 2.—Dr. H. B. Adams in the chair. Twenty-three persons present.

Papers read:

The Township in Maryland, by L. W. WILHELM. (*Abstract on p.* 76).

Local Government in Montgomery County, with a Discussion of the School Question, by A. BOWIE DAVIS, Esq. (*Abstract printed in The Sun, Baltimore, February* 3, 1883).

Critical Note on article "Henry Clay," in the Encyclopædia Britannica, by JOHN C. ROSE. (*Printed in The Nation, February* 15, 1883).

February 9.—Dr. R. T. Ely in the chair. Twenty-five persons present.

Papers read:

An Essay on the Financial History of the United States during the Civil War, by ARTHUR YAGER.

The National Banking System of the United States, by L. W. WILHELM.

February 16.—President Gilman in the chair. Forty-one persons present.

Remarks on the Relation of Physical Geography to the Study of History, by D. C. GILMAN.

February 23.—Dr. H. B. ADAMS in the chair. Twenty-seven persons present.

Papers read:

The Baltimore and Ohio Employés Relief Association, by B. J. RAMAGE. (*Abstract on p.* 77).

Review of recent numbers of Sybel's Historische Zeitschrift, by J. F. JAMESON.

Note on the Origin of the Monroe Doctrine, as explained in D. C. Gilman's "James Monroe," by H. B. ADAMS.

Remarks on the Monroe Doctrine and the Study of History and Politics, by PRESIDENT WHITE of Cornell University.

March 2.—Dr. H. B. Adams in the chair. Thirty-four persons present.

Papers read:

Johann Most in Baltimore, by R. T. ELY. (*The substance of this paper will be incorporated in Dr. Ely's "Lectures on French and German Socialism," to be published by Harper & Brothers*).

The Influence of Schools and Industries upon the Development of Local Life at the South, by the Rev. A. D. MAYO, followed by a discussion of the Expediency of Popular Education, by Dr. G. STANLEY HALL and others.

March 9.—Dr. H. B. Adams in the chair. Twenty-five persons present.

Papers read:

The Spanish Plots in the South-West, by C. H. SHINN. (*To be published in full in the Overland Monthly*).

Review of Conrad's Jahrbücher der National-oekonomie, by R. T. ELY.

March 16.—Dr. H. B. Adams in the chair. Twenty-six persons present.

Papers read:

Special Methods of Historical Study, as pursued at the Johns Hopkins University and Smith College, by H. B. ADAMS. (*To appear as a chapter in a forthcoming volume on Methods of Teaching History, edited by Dr. G. Stanley Hall*).

The Migration Problem, by C. H. SHINN.

March 30.—Dr. H. B. Adams in the chair. Twenty-one persons present.

Papers read:

Old Maryland Manors, by JOHN JOHNSON. (*To appear in May as No. VII. of the University Studies in Historical and Political Science*).

Review of Doyle's "English Colonies in America," by H. B. ADAMS.

Mathematical Society.

February 21.—Dr. Story in the chair. Ten members present.

Papers read:

On the Non-Euclidean Theory of Conics, by W. E. STORY. (*Abstract on p.* 71).

On the Tabulation of Symmetric Functions, by W. P. DURFEE. (*Abstract on p.* 72).

On Partitions, by F. FRANKLIN. (*Abstract on p.* 72).

March 21.—Professor Sylvester in the chair. Thirteen members present.

Papers read:

On the Divisions of Euler's Numbers, by G. S. ELY.

Note on the Strophoids, by E. BARNES.

Note on Conic Sections, by O. H. MITCHELL.

On a General Theorem in Partitions, by J. J. SYLVESTER.

Metaphysical Club.

February 13.—Twenty-eighth regular meeting. Dr. G. Stanley Hall in the chair. Twenty-one members present.

Papers read:

A Study of Reaction, Time, and Attention in the Hypnotic State, by G. S. HALL. (*Published in "Mind," London, April*, 1883).

Mr. Joseph Cook and the Philosophy of Lotze, by J. M. CATTELL.

A Review of Dr. Hopkins' "Outline Study of Man," by A. H. TOLMAN.

March 13.—Twenty-ninth regular meeting. Dr. G. Stanley Hall in the chair. Twenty-two members present.

Papers read

On the Development of Sight in the Lower Organisms, by H. N. MARTIN.

Concerning Perception and Reflex Action in the Frog, by W. T. SEDGWICK.

April 10.—Thirtieth regular meeting. Dr. G. Stanley Hall in the chair. Eight members present.

Papers read:

Hegel and the Theory of Categories, by J. DEWEY.

A note on Mechanical Logic, by J. JASTROW.

Naturalists' Field Club.

February 12.—Dr. W. T. Sedgwick in the chair.

Dr. B. W. Barton, of Baltimore, delivered a lecture upon "The Dispersion of Seeds and the Migration of Plants."

March 12.—Dr. W. T. Sedgwick in the chair.

Mr. H. H. Donaldson read a paper entitled "Notes on a trip to Labrador and New Foundland.

April 9.—Dr. Sedgwick delivered the last lecture of the course, on "The Migration of Birds."

Maryland Historical Society.

February 12.—Annual meeting and election of officers. Reports of officers submitted. The librarian read a list of the State Archives received on deposit from the State.

March 12.—The Publication Committee reported that they had invited Dr. William Hand Browne to the editorship of the State Archives, and that he had accepted the post; that a copyist was at work transcribing the earliest of the records, and that good progress was being made.

Paper: The Maryland Campaign of 1862 (Antietam), by C. F. COBB, of Washington.

April 9.—Paper: The Public Life of John Jay, by WILLIAM WHITELOCK.

The Johns Hopkins University Circulars are printed by Messrs. JOHN MURPHY & CO., 182 West Baltimore Street, Baltimore, from whom single copies may be obtained. They may also be procured, as soon as published, from Messrs. CUSHINGS & BAILEY, No. 262 West Baltimore Street, Baltimore.