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NOTES ON LATIN INSCRIPTIONS FOUND IN BRITAIN.

PART XII.—THE GOVERNORS OF ROMAN BRITAIN.

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75. THE succession of the Imperial Legates is so important an element in fixing the chronology of the Roman period in British history, that an accurate discussion of the subject cannot fail to be useful; especially as, so far as I am aware, no correct list has yet been published. Such an examination, then, with reference not merely to historic, but also to epigraphic records, will form the subject of the present communication.

Before entering into particulars, it may be advantageous to take a general view of the government of Roman Britain.

For the first three centuries, from the time of Claudius to that of Constantine, the Governor of the island was *Legatus Augusti Pro Prætore,* and also *Consularis.* To him was confided the civil and military administration of the Province. The next in authority, under him, was the *Procurator,* the fiscal agent of the Emperor; and, in the absence of both, the government was administered, for the time, by the *Legati Legionum.* See Tacitus, *Hist.* i., 60.

In Constantine's division of the Empire, Britain became a *diœcesis* of the *Præfectura Galliarum*, and was governed by a *Vicarius*, under whom were *Præsides* of its provinces. In the time of the *Notitia*, probably *circa* A.D. 400, this *Vicarius*, or Governor-in-Chief, had under him two *Consulares, viz.*: of *Maxima Cæsariensis*, and of *Valentia*, and three *Præsides, viz.*: of *Britannia Prima*, *Britannia Secunda*, and of *Flavia Cæsariensis*. In addition to these were a *Comes litoris Saxonici per Britanniam*, *Comes Britanniæ*, or *Britanniarum*, and a *Dux Britanniarum*. The *Vicarius*, *Consulares*, and *Præsides*, exercised civil authority; whilst the *Comes litoris Saxonici*, the *Comes Britanniarum*, and the *Dux*, had military command.

I.—During the first Century.

The first eleven governors of Roman Britain are mentioned in order by Tacitus, in his *Agricola*. The following are their names as there given:—

Aulus Plautius,
Ostorius Scapula,
Didius Gallus,
Veranius,
Suetonius Paulinus,
Petronius Turpilianus,
Trebellius Maximus,
Vettius Bolanus,
Petilius Cerialis,
Julius Frontinus,
Cn. Julius Agricola.

This list is satisfactory, so far as informing us of the order of succession; but Tacitus, neither in his *Agricola*, nor elsewhere in his extant works, supplies materials sufficient for defining the beginning and the end of the government of each of those Legates. Let us consider, then, what certain information may be collected relative to these points.

The beginning of the administration of *Aulus Plautius** is certain,

* *Aulus Plautius Silvanus.* I incline to the opinion of *Ed. Mon. Hist. Brit.*, and others, that he is the same as the person named in the inscription found at Tivoli, and given by Gruter, 453, 1., Orelli, n. 750, and *Mon. Hist. Brit.*, 1. Reimar, however, on Dio, lx., 30, expresses the belief that they were different. My opinion is founded on the words of the inscription: LEGAT·ET·COMITI·CLAVD·CAESARIS·IN·BRITANNIA. Now, although it is possible that there may have been two *Plautii* that were *comites* of Claudius

for we know from Dio, lx., 19, 21, that he was sent over by Claudius to the island, in the year when the Emperor was Consul, for the third time, with Vitellius for his colleague = A.D. 43. It would seem, too, as if there were no doubt as to the year in which his administration ended; for Dio, lx., 30, mentions the triumph of Plautius on his return to Rome, and from c. 29 we learn that the year was that in which Claudius was Consul for the fourth time, and Vitellius for the third = A.D. 47.

On the supposition that there was no, or but a short, interval between the end of one administration and the commencement of the next that succeeded, this same year may be regarded as the date of the beginning of the government of Ostorius Scapula. We are, at all events, certain, from Tacitus, *Ann.* xii., 25, that he had command in Britain in the consulship of Antistius and Suillius = A.D. 50.

There is, also,* no doubt as to the year in which *Petronius Turpilianus* succeeded *Suetonius Paulinus,* for we learn from Tacitus, *Ann.* xiv., 39, that it was the year after his consulship, *i.e.* A.D. 62. Now, from Tacitus, *Ann.* xiv., 29, 31, it is clear that Suetonius was in Britain in A.D. 59, 60, and 61.

The statements of Tacitus. *Hist.* ii., 65, that *Trebellius Maximus*

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in Britain, it is scarcely credible that there were two of that name who were both *legati* and *comites* of that Emperor in the island, especially as Tacitus mentions but one. And yet there are objections to this identification. The *Plautius* named in the inscription was *Ti. Plautius M. F.—Silvanus Ælianus;* but this change of *prænomen,* from *Aulus* to *Tiberius,* may have been the consequence of adoption. A much more grave difficulty is found in the words of the inscription: HVNC IN EADEM PRAEFECTVRA VRBIS· IMP·CAESAR·AVG·VESPASIANVS ITERVM COS FECIT. Orelli's note on *iterum cos* is·—"*Consulem suffectum anni incerti. Primum fuerat cos. suffectus V. C.* 800 *p., Chr.* 47." Henzen agrees as to the first consulship, but gives A.D. 76 as the date of the second. But if we accept the identification, how can we reconcile this with the words of Tacitus: "Consularium *primus Aulus Plautius præpositus,*" and of Suetonius, *Vespas.* 4, "*Auli Plautii* Consularis?" If he had been Consul before A.D. 43, and was also Consul in A.D. 47, then his Consulship in A.D. 76 must have been his third, not his second. It seems as if we must either interpret *Consularis,* in both these passages, as meaning "possessed of consular dignity and authority, without having filled the office,"—a sense in which the word is frequently applied to Governors of Provinces—and regard this Plautius as different from the *Aulus Plautius* who had been *consul suffectus* in A.D. 29, or we must reject the identification with the *Plautius,* who was *consul suffectus* in A.D. 47. Of the two solutions, I prefer the first, but I am not satisfied.

* The words of Tacitus are: "*Suetonius* * * * *tradere exercitum Petronio Turpiliano,* qui jam consulatu abierat, *jubetur.*" From this I infer that Turpilianus crossed over to the island in the year after his consulship, which we know to have been in A.D. 61. Horsley, p. 37, takes the same view: "Here," he remarks, "we are also sure, because Tacitus says that Petronius Turpilianus had first finished his consulate; Turpilianus must, therefore, have entered upon the government in Britain in the year 62." And yet Orelli gives A.U.C. 814=A.D. 61, for the commencement of his government, and in this is followed by other editors of the Agricola. Mr. Merivale, *History of the Romans under the Empire,* vii., p. 79, also gives the date A.D. 61.

fled to Vitellius, when Emperor, and that he appointed **e præsentibus Vettius Bolanus* in his place, furnish satisfactory evidence that both these events took place in A.D. 69.

The next date, of which we are certain, is the commencement of the government of *Agricola*, for it is plain, from Tacitus, *Agricola*, 9, that it was in the year after his consulship, *i.e.* A.D. 78; and we have, also, decisive testimony, in the same biography, that he was in the island in 79, 80, 81, 82, 83, and 84.

The positive evidence, then, which we have relative to the beginning and the end of the administration of the first eleven governors, may be stated thus:—

A.D. 43. Beginning of the government of Aulus Plautius.

A.D. 47. End of the government of Aulus Plautius; and succession of Ostorius Scapula.

A.D. 50. Ostorius Scapula victorious in Britain.

A.D. 62. End of the government of Suetonius Paulinus, and beginning of that of Petronius Turpilianus.

A.D. 69. End of the government of Trebellius Maximus, and beginning of that of Vettius Bolanus.

A.D. 78. End of the government of Julius Frontinus, and beginning of that of Cn. Julius Agricola, whose expeditions extend to A.D. 84.

Horsley, *Britannia Romana*, pp. 37, 38, 46, 47, 48, gives the certain dates as I have stated them, with the exception that he places the end of the government of Plautius, and the commencement of that of Ostorius Scapula, in A.D. 50; whilst the following are the results of his enquiry on the doubtful points:—

A.D. 53. Death of Ostorius Scapula, and succession of Didius Gallus.†

A.D. 57. Didius succeeded by Veranius.

A.D. 58. Death of Veranius; and succession of Suetonius Paulinus, in this or, more probably, the following year.

* Mr. Merivale, *Hist. of the Romans under the Empire*, vii., p. 60, remarks: "Trebellius had repaired to Rome, where Vitellius was clutching at the purple; but the tottering Emperor could give him no support. The soldiers rallied together for their own security, and the peace of the province did not suffer by the paralysis of the capital. On the restoration of authority at Rome, Vettius Bolanus was sent to take command, and their recent excesses seem to have been prudently overlooked." These statements are not correct. Trebellius fled to Vitellius in Gaul, and Vettius Bolanus was appointed, cerrainly not at Rome, but probably between Lugdunum and Augusta Taurinorum.

† His name is given by Horsley, whom Mr. Wright follows, as *Avitus Didius Gallus;* but the *prænomen* was really *Aulus*. In Tacitus, *Ann.* xiv., 29, the old reading was *Havitus* or *Avitus Didius;* but this reading was corrected by Lipsius, and his emendation, *A. Didius*, is now generally accepted.

A.D. 65. Petronius Turpilianus succeeded by Trebellius Maximus.
A.D. 71. Vettius Bolanus succeeded by Petilius Cerialis.
A.D. 75. Petilius Cerialis succeeded by Julius Frontinus.
*A.D. 85. End of the government of Agricola.

Orelli's views, as expressed in his notes on the *Agricola*, and adopted by several subsequent editors, differ, in some respects, from those stated by Horsley. He places Aulus Plautius in the years A.U.C. 796–800 = A.D. 43–47; Ostorius, A.U.C. 800–803 = A.D. 47–50; Didius Gallus, from the death of Ostorius to about A.U.C. 810 = A.D. 57; Suetonius Paulinus, A.U.C. 811–114 = A.D. 58–61; Petronius Turpilianus and Trebellius Maximus, A.U.C. 814–822 = A.D. 61–69; Vettius Bolanus, Petilius Cerealis, and Julius Frontinus, A.U.C. 822–831 = A.D. 69–78.

The chief points of difference are as to the dates of the following:

(*a*) The end of the government of Plautius, and the beginning of that of Ostorius Scapula.

(*b*) The death of Ostorius Scapula, and the succession of Didius Gallus.

(*c*) The end of the government of Suetonius Paulinus, and the beginning of that of Petronius Turpilianus.

Horsley was of opinion that Plautius remained as Legate in Britain from A.D. 43 to A.D. 50, in which year he was succeeded by Ostorius; and this opinion he evidently based on the belief that that year —*scil.* 50—was the first of the administration of Ostorius.

Let us examine the grounds of that belief. In the 12th Book of the Annals, c. 25, Tacitus begins the account of the events in the consulship of Antistius and Suillius = A.D. 50. In c. 31 he takes up the affairs of Britain, and remarks: "*At in Britannia* P. Ostorium pro prætore *turbidæ res excipere, effusis in agrum sociorum hostibus eo violentius quod* novum ducem exercitu ignoto *et coepta hieme iturum obviam non rebantur.*" He then proceeds with the narrative of the actions of Ostorius, including the spectacle of Caractacus at Rome before Claudius and Agrippina, and extends his notice of British affairs beyond the death of Ostorius to the administration of his successor, Didius Gallus, concluding his narrative, in c. 40, with the words:—*Hæc quamquam a duobus* [*Ostorio Didioque*] *propræ-*

* I concur in the view that it is more probable that Agricola remained in the island until 85, than that he left in 84.

toribus plures per annos gesta *conjunxi, ne divisa haud proinde ad memoriam sui valerent. Ad temporum ordinem redeo.*

It appears, then, that Tacitus, in chapters 31–40, instead of confining himself to the events of that year, on which he had entered in c. 25, *scil.* A.D. 50, includes those of several—*plures per annos gesta*—and under two governors of Britain. Horsley, believing that the years included by Tacitus were after, not before, that on which he had entered, assumes that Ostorius was *novus dux* in the consulship of Antistius and Suillius. But the authority of Dio, cited p. 305, cannot be neglected; and, if we accept it, we must necessarily place the commencement of the government of Ostorius in the same year of the ovation of Plautius, *i.e.* 47, unless, indeed, we assume that there was a considerable interval between the end of the administration of Plautius and the beginning of that of Ostorius. The notice, then, of British affairs by Tacitus in xii., 31–40, must be regarded as including years both before and after that in which Antistius and Suillius were consuls, *i.e.* both before and after that memorable scene of this year, in which Caractacus appeared before Claudius and Agrippina. There is, certainly, a difficulty in assigning this date to this scene, arising from the use of the term *nono,* in the words *nono post anno quam bellum in Britannia coeptum;* but the true explanation of this seems to be that suggested by Clinton, *Fasti Romani,* p. 34, that *Tacitus supposes the war to have commenced in A.D. 42, one year before the expedition of Plautius.

The death of Ostorius and the succession of Didius Gallus, are placed by Horsley at A.D. 53, whilst Orelli seems to give A.D. 50. Of the two opinions I prefer Horsley's, although, perhaps, the truth lies between the two. If Caractacus was in Rome in A.D. 50, it appears probable that at least another year must be allowed for the reverses of Ostorius, mentioned in c. 38.

In the other discrepancy, *viz.*: as to the end of the government of Suetonius Paulinus, and the beginning of that of Petronius Turpilianus, I believe Horsley's to be the correct view. See note, p. 305.

* There is a similar difficulty in the use of *octavus*, in *Agricola*, c. 33. Mr. Merivale, vii., p. 88, note, suggests the solution, that, "though it was Agricola's seventh, it might be called the eighth campaign of his army; for, in the year preceding his arrival, Julius Frontinus had led an expedition against the Silures.—*Agric.*, 17." Orelli is of opinion, that Agricola counts from the year in which the province was assigned to him, *scil.* A.D. 77, immediately after his consulship, which he held from July 1st to September 1st. Either of these explanations seems preferable to the supposition of a mistake of viii. for vii. See Horsley, *Brit. Rom.*, p. 48.

It appears, then, that the administration of the first eleven governors of Britain extended over 42 years, *scil.* from the third year of Claudius, A.D. 43, to the fifth year of Domitian, A.D. 85.

In addition to these, the twelfth is noticed by Tacitus as the "*successor*" of Agricola, without mention of his name. From Suetonius, *Domitian*, 10, it may be inferred, with some reason, that it was *Sallustius Lucullus*, who was put to death by order of that Emperor. There is no evidence, however, as to either the beginning or the ending of his government.

The next legate, of whom any record is extant, is *C. Salvius Liberalis*, the Orator. We derive the knowledge of his having been governor of Britain from the following inscription, found at *Urbisaglia*, and given by Orelli, n. 1170 :—

[C · SALVI]O · C · T · VEL · LIBERALI
[NONIO] BASSO · COS · PROCOS · PROVIN
[CIAE MA]CEDONIAE · LEGATO · AVGVSTORVM
[PROVINC ·] BRITANN · LEGATO · LEG · V · MACED
[FRATRI ·] ARVALI · ALLECTO · AB · DIVO · VESPASIANO
[ET · DIVO · TI]TO · INTER · TRIBVNICIOS · AB · ISDEM
[ALLECTO ·] INTER · PRAETORIOS · QVINQ · IIII · P · C · HIC · [SORTE
[PROCOS · FAC]TVS · PROVINCIAE · ASIAE · SE · EXCVSAVIT.

Caio Salvio Caii filio Velina (tribu) *Liberali Nonio Basso Consuli Proconsuli provinciæ Macedoniæ Legato Augustorum provinciæ Britanniæ Legato legionis quintæ Macedonicæ Fratri Arvali allecto ab Divo Vespasiano et Divo Tito inter Tribunicios ab iisdem allecto inter Prætorios Quinquennali quartum Patrono Coloniæ. Hic sorte proconsul factus provinciæ Asiæ se excusavit.*

By the expression **Legato Augustorum* here I understand that Caius Salvius was Legate of one Emperor, and, on his death, continued as such under the succeeding Emperor. Now, these may have been either Domitian and Nerva, Nerva and Trajan, or Trajan and Hadrian. It seems most probable that he was the Legate of Nerva and Trajan, *i.e.* that his government extended over A.D. 98, †99.

* This designation is commonly used, as is well known, to signify the Legate of conjoint Emperors; but it seems impossible that this can be its meaning in this inscription, for the first example of two Augusti was in A.D. 161 when Aurelius took Verus as his colleague in the imperial dignity. Nor is there any evidence, so far as I am aware, that Trajan was called Augustus during the life of Nerva.

† In A.D. 100, Liberalis defended Marcius Priscus, when he was accused by Pliny and Tacitus.

II.—During the second Century.

The military diploma found at Malpas, in Cheshire, in 1812, and given in *Mon. Hist. Brit.*, n. 7, *Brit. Rom. Inscrip.*, p. 5, mentions Trajan's legate, in A.D. 104, *scil.* **L. Neratius Marcellus;* but we have no evidence as to the time of his arrival or departure.

From another military diploma, found at Stannington, Yorkshire, in 1761, and given in *Mon. Hist. Brit.*, n. 9, we learn that †*Platorius Nepos* was Hadrian's legate in A.D. 124.

We also know the names of two other legates of this Emperor, *scil. Julius Severus*, from Xiphiline, lxix., 13, and *Pompeius Falco*, from Henzen's Inscrip., n. 5451. Julius Severus was in Britain in A.D. 134, for we may assume, with Clinton, *Fasti Romani*, p. 120, that it was in this year Hadrian sent him to the Jewish war.

Camden, *Introd.*, p. xcvi., *Gough's ed.*, discovered in an ‡inscription another legate under this Emperor, *viz.: Priscus Licinius;* and Horsley believed that he found ||traces of his names in the order *Licinius Priscus*, on a stone found in Cumberland. See *Brit. Rom.*, p. 270. There is no doubt that the celebrated general, *Statius Priscus*, was Governor of Britain; but there is evidence that he was Legate under §Aurelius and Verus, not under Hadrian.

We find no mention of any legate, after Severus and Falco, until we come to *Lollius Urbicus*, the governor under Antoninus Pius, mentioned by Capitolinus, in his life of that Emperor. He gained his victory over the Britons most probably in A.D. 139.

He is noticed in the fragment of an inscription found at Bemulie,

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* See *Brit. Rom. Inscrip.*, p. 8.

† All the British inscriptions have *Platorius*, not *Plætorius*.

‡ This inscription is said, in Speed, *Hist., ed.* 1623, p. 219, to have been found in Britain, at the Picts' Wall; but there seems no reason to doubt that it was found at Rome, as stated in Gruter.

|| I can offer no feasible conjecture as to the name of the legate in this inscription. The remaining letters are thus given by Horsley:—

IICNC IR
V PR PR

At the beginning we have CAESTRA, from which it may be inferred that the Emperor was Hadrian.

§ See Henzen, n. 5480, who gives the inscription in an amended form. From his note it appears that Borghesi identified this governor with the *Priscus*, who was, against his will, proclaimed Emperor by the army in Britain. Thus, also, Mr. Merivale, vii., p. 568, who cites the passage from Constantine Porphyrogenitus.

Scotland, and given by Stuart, *Caledonia Romana*, pl. x., fig. 3, *Brit. Rom. Inscrip.*, p. 262:—

. . . .
P · LEG · IIA
Q · LOLLIO VR
LEG AVG · PR · PR

. . . . . . Patri *Patriæ Legio Secunda Augvsta—Quinto Lollio Urbico Legato Augusti Pro Prætore*

Capitolinus, in his life of Marcus Aurelius, mentions *Calpurnius Agricola*, as a legate in Britain. From the language used by Capitolinus, it may, I think, be inferred, with some probability, that this governor was sent to the island in A.D. 162.

Mr. Wright, *The Celt, the Roman, and the Saxon*, p. 100, 2nd ed., states, with regard to this Emperor:—

"The Roman Province was invaded on the accession of Marcus Aurelius, in 161; but the invaders were checked by a new proprætor, Aufidius Victorinus."

He, accordingly, places him in his list of Roman Governors, p. 468. There is, however, no authority for this statement. Aufidius Victorinus was legate in Germany, not in Britain; and Capitolinus distinctly states, that "Calpurnius Agricola was sent against the Britons, Aufidius Victorinus against the Chatti."

Calpurnius Agricola is named on an altar, found at Caervoran (*Magna*), Northumberlandshire, and given by Horsley, *Brit. Rom.*, n. liii.:—

DEAE SVRI
AE SVB CALP
VRNIO AGR
ICOLA LEG · AVG
PR · PR · A · LICINIUS
CLEMENS PRAEF
III · A · IOR

Deæ Syriæ sub Calpurnio Agricola Legato Augusti Pro Prætore Aulus Licinius Clemens Præfectus Cohortis primæ Hamiorum.

See *Brit. Rom. Inscrip.*, p. 258; *Notes on Lat. Inscrip.*, p. xi.; and *Archæolog. Æliana*, N.S. i., p. 250, n. 101.

Xiphiline, lxxii., mentions *Ulpius Marcellus* as legate of Commodus.

This governor is named, if Mr. Clayton's reading be correct, in the following inscription, on an altar* found at Benwell (*Condercum*), Northumberlandshire, and given in the *Gentleman's Magazine*, December, 1862:—

DEO ANOCITICO
IVDICIIS OPTIMO
RVM MAXIMORVM
QVE IMPP · N · SVB VLP
MARCELLO COS · TINE
IVS LONGVS IN PRAE
FECTVRA EQVITV
LATO CLAVO EXORN. ·
TVS ET Q · D

Deo Anocitico judiciis Optimorum Maximorumque Imperatorum Nostrorum sub Ulpio Marcello Consulari Tineius Longus in præfectura equitum lato clavo exornatus ei Quæstor [?] *designatus* [?].

In *Brit. Rom. Inscrip.*, p. 288, where I have discussed this inscription, I offered the conjecture that the letters at the end of the fourth line, read VIB or VLP, were NER, and that the legate named was *Neratius Marcellus*, Governor in A.D. 104. From further information on the subject, I have reason to believe that Mr. Clayton's reading is correct, *scil.* VLP. Accordingly the *Imperatores Nostri* must be—as suggested by Rev. Dr. Scott (see *Gent. Magazine, November*, 1863)—Aurelius and Commodus, and the date A.D. 177–180. Hence we assume, with probability, that *Ulpius Marcellus* was legate 179 to 184; for it was in this latter year that his achievements in the island won for Commodus the title *Britannicus*. See Clinton, *Fasti Rom.*, p. 182.

Perennis is regarded by some as the successor of Ulpius Marcellus,

* There was found, at the same time and in the same place, another altar, bearing the inscription:—

DEO
ANTENOCITICO
ET NVMINIB·
AVGVSTOR·
AEL·VIBIVS
Ɔ LEG·XX·V·V
V·S·L·M

Nothing is known of the god *Antenociticus* or *Anociticus*. It has occurred to me that their names indicate a Greek origin, as if they had been a pair, whence we have, in the designation of one of them, ANT, *i.e.* ἀντί.

but the evidence does not seem sufficient to prove that he was ever in the island.

From Capitolinus, in his lives of *Pertinax* and *Albinus,* we learn that they also were legates under Commodus, and that *Junius Severus* was sent as successor to Albinus. It is not probable, however, that he succeeded to him, for from Xiphiline, lxxiii., we find that Albinus held the command in Britain in the time of the Emperor Didius Julian, and, after his death, being appointed Cæsar by Severus, he administered the government of the island until A.D. 196, when he passed over to Gaul, where he was defeated and put to death in the following year.

The position of affairs at this time is thus described by Lingard, *Hist. of England,* i., p. 39 :—

"Severus was now undisputed master of the empire. To abolish the exorbitant power of the prefect of Britain, he divided the island into two governments, bestowing the one on Heraclianus, and the other on Virius Lupus."

There is no authority for these two simultaneous governors of Britain, although Lingard refers, in his note, to "Herod., iii., 24, Spartian in Sever., p. 320, Inscriptions in Speed, p. 139." There is evidence in Herodian, that Severus divided the island into two governments. Spartian also states that he sent *Heraclitum ad obtinendas Britannias;* but here we should read *Bithynias,* as Salmasius has suggested. And no inscriptions notice any other governor of the time except Virius Lupus, mentioned by Ulpian, *Digest,* xxvii., 6, 2, and named in the following inscriptions, found in Yorkshire, and given by Horsley, *Brit. Rom.,* pp. 192, n. 62, 311 :—

(1)

DAE FORTVNAE
VIRIVS LVPVS
LEG · AVG PR · PR ·
BALINEVM VI
IGNIS EXVST
VM · COH · I · THR
ACVM REST
ITVIT · CVRAN
TE · VAL · FRON
TONE PRAEF
EQ · ALAE VETTO ·

Deæ Fortunæ Virius Lupus Legatus Augusti Pro Prætore balineum vi ignis exustum Cohors prima Thracum restituit curante Valerio Frontone Præfecto Equitum Alæ Vettonum.

(2) IM · SEVERVS
AVG · ET ANTONINVS
CAES · DESTINATVS
RESTITVERVNT · CV
RANTE VIRIO LVPO
LEG · EORVM PR · PR ·

Imperator Severus Augustus et Antoninus Cæsar Destinatus restituerunt curante Virio Lupo Legato eorum Pro Prætore.

It is not easy to determine satisfactorily the dates of these inscriptions; indeed, the correctness of the readings seems doubtful. The date suggested for the second, by Henzen, is "A.D. 195," with a query, and by the Ed. *Mon. Hist. Brit.*, "Cir. A.D. 197;" but neither of these is satisfactory. We know from Spartian, *Sever.*, c. 10, that Caracalla was appointed Cæsar, with the name *Antoninus*, whilst Severus was on his way to attack Albinus; and this appointment is proved by coins and laws to have taken place in A.D. 196, not at the beginning of it, for Severus was in Mesopotamia at the commencement of the year, from which he returned to Rome, previously to setting out against Albinus; and, besides, the earliest law which we have of Severus and Antoninus, of this year, is dated June 30. Severus had already set out, as we learn from Herodian, iii., c. 20, before Albinus crossed over to Gaul. It was, as I think, at this time, about April or May, 196, whilst Caracalla was yet *Antoninus** *Cæsar destinatus*, that Virius Lupus was sent to occupy the island vacated by Albinus; and, accordingly, we may infer that shortly after his arrival he directed the work commemorated by this inscription. If LEG · AVG ·, in the first inscription, be correct, the date must be either 196 or 197, for Caracalla was *Augustus* in 198; but I suspect that the true reading is AVGG.

III.—During the third Century.

It is not known how long Virius Lupus held the government; *Lucius Alfenus Senecio*, mentioned in several inscriptions found in Britain, and in one found at Naples, Orelli, n. 4405, was, probably, his immediate successor. The following inscription, found at Risingham, Northumberland, and printed, *Archæol. Æliana*, N. S. i., p. 230, *Mon. Hist. Brit.*, n. 192 a., is of the date A.D. 205–207:—

* And yet see a fragment of the *Pontifical Fasti*, Gruter, p. ccc.; Clinton, *Fasti Romani*, p. 200; Eckhel, vii., p. 199.

.................ICO MAXI
COS III ET MAVREL ANTONINO PIO
COS II AVG............................
PORTAM · CVM · MVRIS VETVSTATE DI
LAPSIS IVSSV ALFEN SENECINIS VO
COS CVRANTE OCLATINI ADVENTO PRO
AVGG NN C. I VANGON OPFS
CVM AEMI SALVIAN TRIB
SVO ASOLO RESTI

i.e. [Imperatoribus Cæsaribus Lucio Septimio Severo Pio Pertinaci Augusto Arabico Adiabenico Parth]*ico Maximo Consuli tertium et Marco Aurelio Antonino Pio Consuli secundum Augusto* [et Publio Septimio Getæ nobilissimo Cæsari Consuli] *portam cum muris vetustate dilapsis jussu Alfeni Senecionis Viri Clarissimi Consularis curante Oclatinio Advento procuratore Augustorum Nostrorum cohors prima Vangionum operibus factis cum Æmilio Salviano Tribuno suo a solo restituit.* See *Brit. Rom. Inscrip.*, § 69, where I have discussed the inscription.

In the list of *Legati*, given in the *Mon. Hist. Brit.*, p. cxxv., we find *Papianus* mentioned as having filled that office in "An. 211." The authority referred to for this statement is a passage in the 12th chapter of the XIIth Book of Zonaras, cited and translated in p. lxxxvii., of the same work. The following are the original and the translation, as there given :—

'Αντωνῖνος δὲ . . . τοῖς μὲν πολεμίοις τῶν Βρεττανῶν αὐτίκα ἐσπείσατο, τῆς τε χώρας αὐτοῖς καὶ τῶν φρουρίων ἐκστὰς, τὸν δε ἔπαρχον τὸν Παπιανὸν μετεστήσε τῆς ἀρχῆς.

"Antoninus, moreover, . . . immediately entered into a treaty with such of the Britons as had been his enemies; retiring from their country and fortresses, and appointing Papianus præfect for that góvernment."

The words, mis-translated "appointing Papianus præfect for that government," plainly mean that "he removed the præfect Papianus from his office." This Papianus, otherwise Papinian, the celebrated jurist, was with Severus in Britain as *Præfectus Prætorio.* See Xiphiline, lxxvi.

From the following inscription, found near Welton Hall, Northumberland, and printed, *Mon. Hist. Brit.*, n. 17 a., we learn the name of Caracalla's legate in A.D. 213 :—

* * *	AES MAR
* * *	NTONINO
* * *	CI AVG ARAB
ADIAB · P	RT MAXIM
O BRI.	MAXIMO
TRIB PP	XVI COS IIII
MARTIO	IVL MARCO
LEGA ·	G PP

i.e. Imperatori Cæsari Marco Aurelio Antonio Pio Felici Augusto Arabico Adiabenico Parthico Maximo Britannico Maximo Tribuniciæ Potestatis XVI *Consuli quartum Martio Julio Legato Augusti Propraetore.*

Claudius Paulinus, another legate of the same Emperor, is named in two inscriptions found at High Rochester (*Bremenium*), Northumberland:—

(1) IMP CAE................
..........P · F..........
..........CII · I · F · VARD
....BALLIS · A SOLO R....
SVB · C · CL · APELLINI · LEG · AVG
INSTANTE · AVR · QVINTO · TR ·

Dr. Bruce, *Roman Wall,* p. 459, 2nd ed., reads it thus:—*Imperatori Cæsari Pio Felici Cohors prima Fida Vardulorum ballis? a solo restituit sub Caio Claudio Apellinio Legati Augustali instante Aurelio Quinto Tribuno.*

(2) IMP · CAES · M · AV....
........PIO · F ·....
TRIB · POT..COS....
P · P · BALLIST · A SO..
VARDVL..........
TIB · CL · PAVL........
PR · PR · FEC........
P · AEL...........

i.e. Imperatori Marco Aurelio — Antonino — Pio Felici Tribuniciæ Potestatis — Consuli — Patri Patriæ Ballistarium a solo Cohors prima Fida *Vardulorum — Tiberi — Claudi — Paulin* — Legat — August — *Pro Prætore fecit* instante *Publio Ælio* — —

It is plain that we have in these inscriptions the same legate, *Claudius Paulinus,* who is also named in an inscription found at

Vieux, Normandy. See Smith, *Collect. Antiq.*, iii., p. 98. Line 5 of the first inscription should accordingly be read, as I have suggested, *Brit. Rom. Inscrip.*, p. 162, *Sub cura Claudii Paulini*, &c.

It seems also plain that the second inscription is the older of the two, for in it the making, the erection of the building, is commemorated, of which the restoration is noticed in the first. It is not plain, however, what Emperor is named—whether Caracalla or Elagabalus. Dr. Bruce gives the latter as certain; I rather incline to the former. See *Brit. Rom. Inscrip.*, p. 163.

From an inscription, found at Netherby (*Castra Exploratorum*), Cumberland, and printed *Mon. Hist. Brit.*, n. 40, we learn the name of the legate of Elagabalus in his second year, *scil.* A.D. 219:—

IM. . . . . ANTON
. . P · F AVG BIS COS VEXIL
LEG · II · AVG · ET XX V · V ·
ITEM COH · I · AEL · HISP
M · EQ · SVB CVRA M
D IVNII LEG · AVG · PR · PR . .

i.e. Imperatori Cæsari Marco Aurelio *Antonino Pio Felici Augusto bis Consuli Vexillationes Legionis secundæ Augustæ et vigesimæ Valeriæ Victricis item cohors prima Ælia Hispanorum Miliaria equitata sub cura* (M) *Decimi Junii Legati Augusti Pro Prætore.*

In *Mon. Hist. Brit.* there is a note, in which there is a query whether the Emperor named is Elagabalus, and consequently whether the date is 219. If the reading be correct, the Emperor who is named is certainly Elagabalus; for if it had been Caracalla, who was *bis cos*, his father would have been mentioned. I am not satisfied as to the name of the legate. The M is separated in the *copy, by an interval from CVRA, so that we may not read CVRAM, and this is, besides, unusual. Nor is it probable that it stands for *Marci*. It has occurred to me that, perhaps, there was an O after it, and that IVNII was a misreading for IVLII. We shall thus get MOD · IVLII, *i.e.* †*Modii Julii*, the same legate named on a stone, without date, found at Birdoswald.

An inscription found at Chesters (*Cilurnum*), Northumberland, and printed, *Mon. Hist. Brit.*, n. 66, informs us that *Marius Valerianus* was a legate of the same Emperor in A.D. 221.

* I have seen this inscription only in the *Mon. Hist. Brit.* It is printed, also, by Hodgson, and Lysons, but I am not able to consult either of these authorities.

† In *Brit. Rom. Inscrip.*, p. 30, I have offered a different conjecture.

IMP · CAES ...... AVREL ....
AVG...............................
.... BP. . COS. . DIV
DIVISEVER NEP..................
CAESAR · IMPER..................
ALAE · II · ASTVRV. . .VETVSTAT. . .
ERVNT · PER · MARIVM VALER. A
INSTANTE · SEPTIMO · NILO PRAE
DEDICATVM · III · KAL · NOVEM · GRATO ETSELE

Dr. Bruce, *Roman Wall*, p. 155, 2nd ed., reads it thus:—*Imperatori Cæsari* Marco *Aurelio* — Augusto — Pontifici Maximo *Tribunitia potestate Consuli* iv *Divi* Antonini filio *Divi Severi nepoti Cæsari Imperatori* — Duplares *Alæ II Asturum* templum *vetustate* conlapsum *restituerunt per Marium Valerianun* Legatum Augustalem Propraetorem *instante Septimio Nilo præfecto Dedicatum III Kalendas Novembris Grato et Seleuco* consulibus.

From another inscription, found at Netherby *(Castra Exploratorum)*, Cumberland, and printed, *Mon. Hist. Brit.*, n. 40, we learn that he remained governor under Alexander Severus, in A.D. 222.

IMP CAES M AVRELIO
SEVERO ALEXANDRO PIO FEL AVG
PONT MAXIMO TRIB POT COS PP COH I AEL
HISPANORVM M EQ DEVOTA NVMINI
MAIESTATIQUE EIVS BASELICAM
EQVESTREM EXERCITATORIAM
IAMPRIDEM A SOLO COEPTAM
AEDIFICAVIT CONSVMMAVITQVE
SVB CVRA MARI VALERIANI LEG
AVG PR PR INSTANTE M AVRELIO
SALVIO TRIB COH · IMP · D · N ·
SEVERO ALEXANDRO PIO FEL
AVG COS

Imperatori Cæsari Marco Aurelio Severo Alexandro Pio Felici Augusto Pontifici Maximo Tribunitiæ Potestatis Consuli Patri Patriæ Cohors prima Ælia Hispanorum Miliaria Equitata devota numini majestatique ejus basilicam equestrem exercitatoriam jampridem a solo coeptam ædificavit consummavitque sub cura Marii Valeriani Legati Augusti Pro Prætore instante Marco Aurelio Salvio Tribuno Cohortis Imperatore Domino Nostro Severo Alexandro Pio Felice Augusto Consule.

In *Mon. Hist. Brit.* there is a note on the final COS, assigning the date A.D. 222–225. But, if the reading of the third line be correct, it was not only his first consulship, but also the first year of his tribunician power. Hence it appears that the date is A.D. 222.

In A.D. 225, the Emperor Alexander Severus had a different legate, whose *cognomen* was *Maximus*, as appears from the following, found at Great Chesters *(Æsica)*, Northumberland, and printed *Arch. Æliana*, N. S., i., p. 226, *Brit. Rom. Inscrip.*, p. 155:—

IMP · CAES MAVR SEVE
RVS ALEXANDER P FE
AVG HORREVM VETV
STATE CONLABSVM M
COH II ASTVRVM S · A
A SOLO RESTITVERVNT
PROVINCIA REG........
MAXIMO LEG..........
KAL MARTI
FVS

Imperator Cæsar Marcus Aurelius Severus Alexander Pius Felix Augustus horreum vetustate conlapsum milites Cohortis secundæ Asturum Severianæ Alexandrianæ a solo restituerunt provincia[m] *regente* —— *Maximo Legato* Augusti Pro Prætore — *Kalendis Martiis* —— *Fusco* II · et Dextro Consulibus. See *Brit. Rom. Inscrip.*, p. 156.

In an inscription, found at Carrawburgh *(Procolitia)*, Northumberland, and figured, Bruce's *Roman Wall*, 2nd ed., p. 165, we have fragments of the name of the legate of Maximinus, in A.D. 237:—

.......................M
...................MAX
...................RCOS
.... ARMS
..........CAES N · SVB · S
.........CCIANO VC LEG
......COH I BATAVORVM
......ANTE BVRRIO.....
........TO PRAE........
........RNELIANO......

The following are Dr. Bruce's comments:—

"The words COH I BATAVORVM are quite distinct. The line following may probably be read [INST]ANT[E] BVRRIO, and bears the name of the prefect under whose superintendence the building was erected, to which the slab referred. In the last line, the word [CO]RNELIANO may be perceived. In 237, when Maximinus was Emperor, Titius Perpetuus and Rusticus Cornelianus were consuls. That this is the date of the inscription is rendered likely from a fragment of the Emperor's name appearing in the beginning of it."

This determination of the date is well and satisfactorily done; but MAX in the second line probably stands for *Maximus,* following Dacicus, Germanicus, or some such title, the M in the first line being the second in Maximinus. RCOS, in the third, may be part of PROCOS. ARMS, in the fourth, is a portion of *Sarmaticus,* a title of his son *Maximus,* the Cæsar. The name of the legate may have been *Salvius Coccianus,* the same as that borne by Otho's nephew mentioned in Tacitus, *Hist.*, ii., 48.

Nonnius Philippus was the Emperor Gordian's legate in A.D. 242, as appears from the following inscription, found at Old Penrith, Cumberland, and printed, Horsley's *Brit. Rom. Cumberland,* n 55 :—

I O M
PRO SALVTE IMPERATORIS
M ANTONI GORDIANI P · F ·
INVICTI AVG ET SABINIAE FVR
IAE TRANQVILE CONIVGIEIVS TO
TAQVE DOMV DIVIN · EORVMA
LA AVG GORDIA OB VIRTVTEM
APPELLATA POSVIT CVI PRAEEST
AEMILIVS CRISPINVS PRAEF
EQQ NATVS IN PRO AFRICA DE
TVSDRO SVB CVR NONII PHI
LIPPI LEG · AVG · PRO PRETO
ATTICO ET PRAETEXTATO
COSS

Jovi Optimo Maximo pro salute Imperatoris Marci Antonii Gordiani Pii Felicis invicti Augusti et Sabiniæ Furiæ Tranquillæ conjugi[s] *ejus totaque domu divina eorum ala Augusta Gordiana ob virtutem appellata posuit cui præest Æmilius Crispinus præfectus Equitum natus in Provincia Africa de Tusdro sub cura Nonnii Philippi Legati Augusti Pro Prætore Attico et Prætextato Consulibus.*

Egnatius Lucilianus and *Mæcilius Fuscus* were also legates of the same Emperor, but we do not know their dates. Perhaps, as Horsley thought, they preceded Nonnius Philippus. They are named in the following inscriptions, found at Lanchester, Durham, and printed, Horsley's *Brit. Rom. Durham*, xi. xii., *Brit. Rom. Inscrip.*, p. 56:—

IMP · CAES · M · ANT · GORDIA
NVS · P · F · AVG · BALNEVM · CVM
BASILICA A SOLO INSTRVXIT
PER EGN LVCILIANVM · LEG AVG
PR · PR · CVRANTE M · AVR
QVIRINO PRE · COH I L GOR

*Imperator Cæsar Marcus Antonius Gordianus Pius Felix Augustus balneum cum basilica a solo instruxit per Egnatium Lucilianum Legatum Augusti Pro Prætore curante Marco Aurelio Quirino Præfecto Cohortis primæ *Lingonum Gordianæ.*

IMP · CAESAR · M · ANTONIVS
GORDIANVS · P · F · AVG
PRINCIPIA ET ARMAMEN
TARIA CONLAPSA RESTITV
IT PER MAECILIVM FVSCVM · LEG
AVG · PR · PR · CVRANTE M · AVR
QVIRINO PR · COH · I · L · GOR

*Imperator Cæsar Marcus Antonius Gordianus Pius Felix Augustus principia et armamentaria conlapsa restituit per Mæcilium Fuscum Legatum Augusti Pro Prætore curante Marco Aurelio Quirino Præfecto Cohortis primæ *Lingonum Gordianæ.*

We have no account of any legate between the times of Gordian and Valerian and Gallienus. Under the reign of the latter, in A.D. 254–260, Desticius Juba was was Governor in the island, as we learn from the following inscription, found at Caerleon (*Isca Silurum*), Monmouthshire, and figured in Lee's *Isca Silurum*, pl. 5, fig. 1:—

IMPP · VALERIANVS ET GALLIENVS
AVGG · ET VALERIANVS NOBILISSIMVS
CAES · COHORTI VII · CENTVRIAS · A SO
LO RESTITVERVNT · PER · DESTICIVM IVBAM
VC · LEGATVM AVGG · PR · PR · ET
VITVLASIVM LAETINIANVM LEG · LEG
II · AVG · CURANTE · DOMIT · POTENTINO
PRAEF · LEG EIVSDEM

* See *Brit. Rom. Inscrip.*, p. 57.

Imperatores Valerianus et Gallienus Augusti et Valerianus Nobilissimus Cæsar cohorti septimæ centurias a solo restituerunt per Desticium Jubam Virum Clarissimun Legatum Augustorum Pro Prætore et Vitulasium Lætinianum Legatum Legionis secundæ Augustæ curante Domitio Potentino Præfecto Legionis ejusdem.

The date is between A.D. 254–260. See *Brit. Rom. Inscrip.*, p. 125, and *Notes on Latin Inscrip.*, part x.

Desticius Juba is the latest Governor named in dated inscriptions found in Britain. He is also mentioned in inscriptions found on the continent: see *Museum Veronense*, cccxxvii., 2, and Orelli, n. 4913. In the list, given in *Mon. Hist. Brit.*, p. lxxv., the next in chronological order is Victorinus, dated "277?" and Zosimus and Zonaras are referred to as authorities for the insertion of his name; but it cannot be inferred from the statements of either that Victorinus was ever Governor of the island.

Vopiscus informs us that Britain, in the reign of the Emperor Carus, *i.e.* A.D. 282–283, was under Carinus, as Cæsar.

From A.D. 287 to A.D. 293, Britain was ruled by Carausius, who, from A.D. 290, was recognized as Augustus; his murderer, Allectus, held the island until A.D. 296, when, on his defeat and death, the authority of Constantius was established.

IV.—During the fourth Century.

In A.D. 306, the Emperor Constantius died at York, and was succeeded by his son, Constantine the Great. In his reign, in his consulship with Licinius Cæsar, = A.D. 319, Pacatianus was his *Vicarius* in the island, as we learn from the Theodosian Code, xi., 7, 2.

Our only authority for the next fifty years is Ammianus Marcellinus, and his statements are very meagre. In xxx., 7, 5, he mentions *Gratianus Funarius*, the father of the Emperor Valentinian, who "Comes præfuit rei castrensi *per Africam *** et multo postea* pari potestate *Britannicum rexit exercitum*." He is regarded as Governor by Horsley, *Brit. Rom.*, in A.D. 353, and by *Ed. Mon. Hist. Brit.*, p. 139, in "A.D. 350;" but it is plain that he was not *Vicarius*, but *Comes rei militaris*. See *Ammianus Marcellinus*, vol. iii., p. 455, ed. Erfurdt.

In xiv., 5, 6, *Martinus* is noticed as holding the official rank in Britain of *pro præfectis*, and is also, in the same chapter, called

Vicarius. His administration of Britain may be placed in A.D. 353, as in *Mon. Hist. Brit.*, p. 139; Horsley, however, gives A.D. 355.

In xxiii., 1, 2, *Alypius* is mentioned, "qui olim Britannias curaverat pro præfectis." In *Mon. Hist. Brit.*, p. 140, he is placed in A.D. 360, and in *Brit. Rom.*, in A.D. 361; but neither of these dates seems to agree with the word *olim*, as used by Ammianus Marcellinus in describing an event* that, we know, took place in A.D. 363. From xx., 1, we learn that *Lupicinus* was sent over with an army to chastise the Picts and Scots. The words *consulatu Constantii decies terque Juliani*, seem to fix the date to A.D. 360, as given in *Mon. Hist. Brit.*, p. 140; but Horsley prefers A.D. 361.

The same historian, in xxviii., 8, informs us that Valentinian, having heard of a revolt in Britain, in which Nectaridus, *Comes maritimi tractus*, was killed, and Fullofaudes, the *Dux*, was in imminent danger, despatched to the island *Severus*, who was, at this time, *Comes domesticorum;* and it is stated that he sent before him *Provertuides* to collect an army. On his recall, *Jovinus* was appointed; subsequently, on receiving more alarming intelligence, *Theodosius* (father to Theodosius I.), an officer of high military reputation, was sent over. He subsequently applied for the appointment of *Civilis*, as Governor (*Vicarius*), and *Dulcitius* as General (*Dux*), and pursued a most successful career for about two years. The missions of Severus and Jovinus may be placed in A.D. 367; the arrival of Theodosius in A.D. 368, and his departure in A.D. 370. Horsley, *Brit. Rom.*, places the mission of Severus in A.D. 365; that of Jovinus in A.D. 366; and the arrival of Theodosius in A.D. 367.

The last notice that we find in Ammianus relative to Britain, is the incidental mention of *Fraomarius*, king of the Bucinobantes, who was sent into the island *potestate tribuni*, *i.e.* as commander of a body of auxiliaries. This may be placed about A.D. 370, as in *Brit. Rom.*, or A.D. 372, as in *Mon. Hist. Brit.*

In A.D. 383, the army in Britain proclaimed *Maximus* Emperor, as we learn from Socrates, v., 11, Zosimus, iv., 35, 5, 7, and Victor, *Epit.* The last Governor, whose name has been preserved, is *Chrysanthus*, mentioned by Socrates, i., 2.

In addition to the Governors already named, we must add those whose dates are unknown, and those whose title to this dignity is doubtful; viz.:

* The attempt by Julian to rebuild the temple at Jerusalem. Alypius was placed by th Emperor in charge of the work.

a) *Claudius Xenephon* (*sic*); (*b*) *Modius Julius*; (*c*) *Æmilianus Calpurnius Rufilianus*; (*d*) *T. Flavius Postumius Varus*; (*e*) *Cogidubnus*; (*f*) *Octavius Sabinus*; (*g*) *Julius Pitanus*; (*h*) *Q. Antonius Isauricus*; (*i*) *T. Pomponius Mamilianus Rufus Antistianus Funisulanus Vettonianus*; (*k*) *Antistius Adventus**.

(*a*) Found at Little Chesters (*Vindolana*), Northumberland, and printed, Horsley, *Brit. Rom.*, p. 192, n. 21, *Brit. Rom. Inscrip.*, p. 136.

.... GALLOR
.... VOTANV
.. NIEIVS POR /RRIBVS..........
FVNDAMEN........ ERVNT SVB..
CL · XENEPHO........EG AV PR..
CVRANTE.........................

— — Cohors — *Gallorum devota numini ejus portæ turribus — — fundamenta — posuerunt sub — Claudio Xenephonte — Legato Augusti Pro Prætore curante — —*

(*b*) Found at Birdoswald (*Amboglanna*), Cumberland, and printed, *Archæol. Æliana*, N. S. i., p. 234, *Brit. Rom. Inscrip.*, p. 29.

SVB · MODIO IV
LIO LEG AVG PR ·
PR COH I AEL DC
CVI PRAEEST M
CL MENANDER
TRIB

Sub Modio Julio Legato Augusti Pro Prætore Cohors prima Ælia Dacorum cui præest Marcus Claudius Menander Tribunus.

(*c*) Found at Caerleon (*Isca Silurum*), Monmouthshire, and printed, Horsley, *Brit. Rom.*, p. 322.

IOVI · O · M · DOLICHV
I.. ONIO AEMILIANVS
CALPVRNIVS
RVFILIANVS .. EC
AVGVSTORVM
MONITV

---

* In addition to these, Horsley mentions *Trebellius* as Governor, "but uncertain at what time." He is also noticed in Camden's *Britannia*, ed. Gough, i., p. 93.

Camden read this thus: *Jovi Optimo Maximo Dolicheno Junoni Optimæ Æmilianus Calpurnius Rufilianus fecit Augustorum monitu.* This seems to be adopted by Horsley, *Brit. Rom.*, p. 323. I have but little doubt, however, that the last letter of the fourth line should have been read G, *i.e.* EG *scil.* LEG. Thus, Rufilianus was *Legatus Augustorum*, and *monitu* refers to the direction of the deities.

(*d*) Found at Caerleon, Monmouthshire, and figured, Lee, *Isca Silurum*, pl. iii., fig. 4.

T · FL · POSTVMIVS VARVS
V · C · LEG · TEMPL · DIANAE
RESTITVIT

Titus Flavius Postumius Varus Vir Cl   simus Legatus templum Dianæ restituit.

The usual addition to LEG · of PR · PR · is here omitted; but from the use of V · C ·, *Vir Clarissimus*, there is, I think, no doubt that Postumius Verus was Governor, not merely *Legatus* of the legion stationed at *Isca, scil.* the 2nd *Augusta*.

(*e*) Found at Chichester, Sussex, and printed, Horsley, *Brit. Rom.*, p. 192, n. 76.

[N]EPTVNO · ET · MINERVAE
TEMPLVM
[PR]O · SALVTE · DO[MVS ·] DIVINAE
AVCTORITA[TE · TIB ·] CLAVD
[CO]GIDVBNI · R · LEGA AVG · IN BRIT
[COLE]GIVM · FABROR · ET QVI · IN EO
.... D · S · D · DONANTE AREAM
.... ENTE PVDENTINI · FIL ·

Neptuno et Minervæ templum pro salute Domus Divinæ auctoritate Tiberii Claudii Cogidubni Regis Legati Augusti in Britannia Collegium Fabrorum et qui in eo (consistunt) *de suo dederunt donante aream — ente Pudentini filio.*

There seems no sufficient reason for doubting that the *Cogidubnus* of the inscription is the same as *Cogidunus*, mentioned by Tacitus, *Agricola*, 14: *Quædam civitates* Cogiduno regi *erant donatæ. Is ad nostram usque memoriam fidissimus remansit.* We may assume, then, that *Cogidunus* ruled those *civitates*, that were presented to him, as *Legatus Augusti.*

The use of *domus divina, i.e.* "the imperial family," is remarkable, for if this inscription was cut in the life-time of Cogidunus, it can scarcely have been later than the reign of Domitian, while the earliest of all other known examples of this phrase is in the reign of Marcus Aurelius.

(*f*) Found at Lancaster, and printed, *Mon. Hist. Brit.*, n. 76.

. . . .
. . [OB ·] BALINEVM REFECT
[ET · BA]SILICAM VETVSTATE CONLABSAM
[A] SOLO RESTITVTAM · EQQ · AL · SEBVSSIA
[NAE] SVB OCTAVIO · SABIN[O] VC
PRAESIDE · N · CVRANTE · FLA · AMMAV
SIO · PRAEF · EQQ · D · D · XI · KAL · SEPTEM ·
CENSORE $\overline{II}$ · ET · LIP . . O . . . . $\overline{II}$ · COSS

i.e. Ob balineum refectum et *basilicam vetustate conlapsam a solo restitutam equites Alæ Sebussianæ sub Octavio Sabino Viro Clarissimo Præside Nostro curante Flavio Ammausio Præfecto Equitum dono dederunt X' Kalendas Septembres Censore iterum et Lepido? iterum Consulibus.*

The date is unknown, as the year in which Censor and Lip. . . . were *Consules suffecti* has not been ascertained.

(*g*) Found at Cambeck, and printed, Horsley, p. 192, n. 43, *Brit. Rom. Inscrip.*, p. 219.

. . . .
OMNIVM
GENTIVM
TEMPLVM
OLIM VETVS
TATE CONIAB
SVM C · IVL
PITANVS
P · P · RESITUIT ·

Matribus *omnium gentium templum olim vetustate conlapsum Gaius Julius Pitanus primi pilus restituit.*

Horsley reads P · P ·, *Provinciæ Præses;* I prefer *Primipilus.* See *Brit. Rom. Inscrip.*, p. 220.

(*h*) Found at York, and printed, Wellbeloved, *Eburacum*, p. 90, *Brit. Rom. Inscrip.*, p. 216.

DEAE
FORTVNAE
SOSIA
IVNCINA
Q · ANTONI
ISAVRICI
LEG · AVG

i.e. Deæ Fortunæ Sosia Juncina (uxor) *Quinti Antonii Isaurici Legati Augusti.*

It is doubtful whether *Legatus Augusti* means Governor, or commander of the legion, stationed at York, *scil.* the 6th *Victrix*.

(*i*) Found at Chester, and printed, Smith, *Collect. Antiq.*, vi., p. 40.

FORTVNAE REDVCI
ESCVLAP ET SALVT · EIVS
LIBERT ET FAMILIA
I · IIMPONI · T · F · GAL · MAMILIAN
RVFI . . TISTIANI FVNISVL. N
VETTONIANI · LEG · AVG ·
D · D ·

Mr. Roach Smith, *Collect. Antiq.*, vi., p. 41, reads and explains this thus:—

"*Fortunæ Reduci, Æsculapio, et Saluti ejus Liberti et Familia Pomponii* (?) *T. Filii* (*Galeriæ*) *Mamiliani Rufi Antistiani Funisulani Vettoniani Legati Augustali dedicaverunt.* This altar was dedicated to Fortuna Redux, to Æsculapius, and to Salus (a combination of divinities, of which there are many examples in similar inscriptions), by the household (*liberti et familia*) of an imperial legate (most probably of the twentieth legion), of many names, occupying nearly three lines in the inscription. These names, indeed, present the only difficulty in the dedication, as the lettering is partially defective. They appear to belong to one individual, T.? Pomponius Mamilianus Rufus Antistianus Funisulanus Vettonianus, of the Galeria family."

To these observations are added the remarks of the Rev. J. Bathurst Deane, "on this hitherto unexplained inscription:—"

"I have reasons for thinking that T. Pomponius Funisulanus Vettonianus was legate of the twentieth legion about the year A.D. 295, or perhaps, somewhat earlier; and I believe him to have been adopted into the family of Funisulanus Vettonianus, mentioned by Tacitus, *Annal.*, xv., 7 (A.D. 72), whom I take to be the father of the L. Funisulanus Vettonianus (*circa* A.D. 100) who, was tribune of the sixth legion (Leg. vi. Vic.) in Britain, in the time of Nerva."

Mr. Smith's explanation is, in the main correct, but there are some points that require notice. GAL· stands for *Galeriâ, scil.* tribu, *Augustali* should have been *Augustalis*, or, rather, *Augusti*, and the meaning of EIVS seems to have been overlooked. It is scarcely possible that the pronoun can refer to *T. Pomponius*, &c.; I regard it as used for *ejus filiæ, i.e. Salus* his daughter, *scil.* of Æsculapius. There are similar examples of ellipsis both in Greek and Latin.

It is plain that Mr. Deane's remarks have been written without sufficient consideration. The date of the "Funisulanus Vettonianus, mentioned by Tacitus, *Annal.*, xv., 7," is not "A.D. 72," but A.D. 62; and it is impossible that "L. Funisulanus Vettonianus (*circa* A.D. 100)," or any one else, can have been tribune of the sixth legion (Leg. vi. Vic.) in Britain, in the time of Nerva, for that legion was not in the island until the time of Hadrian. Again, the date of "the L. Funisulanus Vettonianus" to whom Mr. Deane refers—*scil.* the same mentioned in the inscription cited by Brotier, in his *Notæ et Emendationes*, on Tacitus, *Ann.*, xv., 7—is not "*circa* A.D. 100," but *circa* A.D. 86, for the Dacian war in which he served was not that under Trajan, but that under Domitian. Nor is there any ground for supposing that the person named in the inscription was the son of the Funisulanus Vettonianus mentioned by Tacitus. It is plain that both notice the same person, who was *Legatus legionis quartæ*. On the inscription (cited by Brotier) found at *Turopoglys*, in Croatia, see Henzen, n. 5431, and especially Borghesi, *Giorn. Arcad.*, vii., p. 376.

What "the reasons" can be that Mr. Deane says that he has "for thinking that T. Pomponius Funisulanus Vettonianus was legate of the twentieth legion about the year A.D. 295, or perhaps somewhat earlier," I am wholly at a loss to conjecture. It is certain that an inscription was found at Chester, in which the 20th legion is mentioned, and in which, also, are found *Domini Nostri Augusti invictissimi*. Now, as these were, probably, Diocletian and Maximian, we may thus get a date for the presence of the legion there "about the year A.D. 295," but neither in that inscription, nor in any other record, is there evidence sufficient to warrant a conjecture as to the date at which *Pomponius Funisulanus* commanded the twentieth leigon: indeed, it is not certain that he ever commanded it at all.

(*k*) Found at Lanchester, Durham, according to *Mus. Ver.*, ccccxlv., 9, and *Orelli, Inscrip.*, n. 3403.

NVM · AVG · ET
GEN · COH · II
VARDVLORVM
C · R · EQ · M · SVB · AN
TISTIO ADVEN
TO LEG · AVG · PR · PR
....TIANVS TRIB

i.e. Numini Augusti et Genio Cohortis secundæ Vardulorum Civium Romanorum Equitatæ Miliariæ sub Antistio Advento Legato Augusti Pro Prætore — tianus Tribunus.

I am persuaded that this stone was not found in England. From Orelli, n. 1270, we learn that *C. Antistius Adventus* was Legate of Germany.

In Wright's *Celt, Roman, and Saxon,* p. 364, we have the following statements :—

"C. Valerius Pansa occurs, as holding the same office [of proprætor] under Trajan, in an inscription found at Novara, in Italy, published by Muratori. Quintus Calpurnius is mentioned in an inscription found in Northumberland, believed to be of the age of Commodus."

Neither of these statements is correct. C. Valerius Pansa did not hold the office of proprætor, and the Quintus Calpurnius, to whom Mr. Wright refers, *scil. Quintus Calpurnius Concessinius,* was not legate, but merely a *Præfectus Equitum.* See *Brit. Rom. Inscrip.*, p. 193.

In *Mon. Hist. Brit.*, p. cxlvi., *C. Valerius Pansa* and *M. Mænius Agrippa,* are given as *Proconsules,* but in both these cases there is the same mistake, caused by reading PROC ·, *Proconsul,* instead of *Procurator.* See *Brit. Rom. Inscrip.*, p. 254. Britain was never a Proconsular Province; the Emperor himself was the only Proconsul of it, as of his other provinces. And yet we find in Lingard, *History of England,* i., p. 45 : "*Pomponia Græcina,* the wife of the proconsul Plautius ;" and in Merivale, *Hist. of the Romans under the Empire,* vii., pp. 79, 81 : "Trebellius Maximus had mitigated the severity of the proconsular government,"—"Petilius Cerealis, the next proconsul," —"C. [Cn.] Julius Agricola, consul, A.D. 77 ; proconsul in Britain, A.D. 78." There was not one of those Governors who was a *Proconsul ;* each of them was *Legatus Augusti Proprætore.*

With a view to facility of reference, I add a synopsis, giving the principal results of the foregoing examination.

First Century.

EMPERORS.	*GOVERNORS.		A.D.
CLAUDIUS, A.D. 41 to 54.	Aulus Plautius,	*Legatus Augusti Pro Prætore,*	43 to 47
	P. Ostorius Scapula,	" " " "	47 to *52
	A. Didius Gallus,	" " " "	*52 to
NERO, 54 to 68.	A. Didius Gallus,	" " " "	... *57
	Quintus Veranius,	" " " "	*57 to *58
	C. Suetonius Paulinus,	" " "	*58 to 62
	C. Petronius Turpilianus,	" " "	62 to *65
	Trebellius Maximus,	" " " "	*65 to
GALBA, 68 to 69.	Trebellius Maximus.		
OTHO, 69.	Trebellius Maximus.		
VITELLIUS, 69.	Trebellius Maximus,	" " " "	... 69
	Vettius Bolanus,	" " " "	69 to ...
VESPASIAN, 69 to 79.	Vettius Bolanus,	" " " "	... *71
	Petilius Cerealis,	" " " "	*71 to *75
	Sex. Julius Frontinus,	" " "	*75 to 78
	Cn. Julius Agricola,	" " " "	78 to *85
TITUS, 79 to 81.	Cn. Julius Agricola.		
DOMITIAN, 81 to 96.	Cn. Julius Agricola,	" " " "	... *85
	Sallustius Lucullus,	" " " "	?... to ...?
NERVA, 96 to 98.	*C. Salvius Liberalis,*	" " " "	?... to

Second Century.

TRAJAN, 98 to 117.	*C. Salvius Liberalis,*	" " " "	*99 ?
	†*L. Neratius Marcellus,*	" " "	?... 104 ...?
HADRIAN, 117 to 138.	†*A. Platorius Nepos,*	" " "	?... 124 ...?
	Julius Severus,	" " " "	?... 134 ...?
ANTONINUS PIUS, 138 to 161.	†Q. LOLLIUS URBICUS,	" " "	?... *139 ...?
	M. STATIUS PRISCUS,	" " "	?... to
M. AURELIUS AND VERUS, 161 to 169.	M. STATIUS PRISCUS,	*Leg. Augg. Pro Prætore,*	*161
	†CALPURNIUS AGRICOLA,	" " "	*162 to ...?
M. AURELIUS, 169 to 177.			
M. AURELIUS AND COMMODUS, 177 to 180.	ULPIUS MARCELLUS,	" " "	?... to‡179

* The names in Roman letters, are of those mentioned as Governors only in histories, &c. in Italics, only in inscriptions; in Capitals, in both histories, &c., and inscriptions; and the Obelisk distinguishes those that are found in British inscriptions. The Asterisk, prefixed to a date, marks it as probable, not certain; and the mark of Interrogation indicates the want of information as to the beginning or end of the administration.

‡ The objection to this date, or to any other year of the joint reign of Marcus Aurelius and Commodus, as derived from the Benwell inscription, is that Xiphiline, lxxviii., 2, states that Ulpius Marcellus was sent by Commodus against the insurgent Britons. This may be met by the supposition that he continued in office up to the time of the outbreak, and was then sent by Commodus, not from the continent, but from the part of the island in which he then was, to the north, where the insurgents had crossed the barrier. This interpretation, however, seems unsatisfactory.

EMPERORS.	GOVERNORS.		A.D.
COMMODUS, 180 to 192.	†ULPIUS MARCELLUS,	*Leg. Aug. Pro Prætore,*	... 184 ...?
	Helvius Pertinax,	" " "	*186 to *187
	D. Clodius Albinus,	" " "	*187 to ...
PERTINAX. 193.	D. Clodius Albinus.		
JULIAN. 193.	D. Clodius Albinus.		
SEVERUS, 193 to 198.	D. Clodius Albinus.	" " "	... 196
	†VIRIUS LUPUS,	*Leg. Augg. Pro Prætore,*	*196 to ...?

THIRD CENTURY.

EMPERORS.	GOVERNORS.		A.D.
SEVERUS AND CARACALLA, 198 to 211.	†*L. Alfenus Senecio,*	" " "	?...205-207...?
CARACALLA AND GETA, 211 to 212.			
CARACALLA, 212 to 217.	†*Martius Julius Marcus,*	*Leg. Aug. Pro Prætore,*	?... 213 ...?
	†*Ti. Claudius Paulinus,*	" " "	?... to ...?
MACRINUS, 217 to 218.			
ELAGABALUS, 218 to 222.	†*D. Junius,*	" " "	?... 219 ...?
	†*Marius Valerianus,*	" " "	?... 222 ...?
SEVERUS ALEXANDER, 222 to 235.	†*Marius Valerianus.*		
	†—— *Maximus,*	" " "	?... 225 ...?
MAXIMINUS, 235 to 238.	†*S. Coccianus, ?*	" " "	?... 237 ...?
GORDIAN, 238 to 244.	†*Egnatius Lucilianus,*	" " "	?... to ...?
	†*Mæcilius Fuscus,*	" " "	?... to ...?
	†*Nonnius Philippus,*	" " "	?... 242 ...?
PHILIP, 244 to 249.			
DECIUS, 249 to 251.			
GALLI, 251 to 254.			
VALERIAN AND GALLIENUS, 253 to 260.	†*T. Desticius Juba,*	*Leg. Augg. Pro Prætore,*	?...254-260...?
GALLIENUS, 260 to 268.			
CLAUDIUS, 268 to 270.			
AURELIAN, 270 to 275.			
TACITUS, 275 to 276.			
‡PROBUS, 276 to 282.			
CARUS, 282 to 283.	M. Aurelius Carinus, *Cæsar.*		
CARINUS AND NUMERIANUS, 283 to 284.			
DIOCLETIAN, 284 to 286.			

‡ Some have stated that this Emperor visited Britain, but the evidence is insufficient.

EMPERORS.	GOVERNORS.	A.D.
DIOCLETIAN AND MAXIMIAN, 286 to 290.	M. Aurel. Valer. Carausius	287 to 293
DIOCLETIAN, MAXIMIAN, AND CARAUSIUS, 290 to 293.	Allectus	293 to 296

FOURTH CENTURY.

DIOCLETIAN AND MAXIMIAN, 293 to 305.		
CONSTANTIUS AND GALERIUS, 305 to 306.	Death of the Emperor Constantius, and elevation of Constantine in Britain.	306
CONSTANTINE AND GALERIUS, 306 to 307.		
‡CONSTANTINE, GALERIUS, AND LICINIUS, 307 to 310.		
‡CONSTANTINE AND LICINIUS, 310 to 322.	Pacatianus, *Vicarius*	?... 319 ... ?
CONSTANTINE, 322 to 337.		
CONSTANTINE II., CONSTANTIUS II., AND CONSTANS, 337 to 340.		
CONSTANTIUS II. AND CONSTANS, 340 to 350.		
CONSTANTIUS II., 350 to 361.	Gratianus Funarius, *Comes rei Castrensis*	*350
	Martinus, *Vicarius*	?... *353 ... ?
	Alypius, *Vicarius*	?... 365 ?... ?
	Lupicinus, *Magister Equitum*	360
JULIAN, 361 to 363.		
JOVIAN, 363 to 364.		
VALENTINIAN AND VALENS, 364 to 367.		
VALENTINIAN, VALENS, AND GRATIAN, 367 to 375.	Nectaridus, *Comes maritimi Tractus*	367
	Fullofaudes, *Dux*	367
	Severus	367
	Jovinus	367
	Theodosius	368-370
VALENS AND GRATIAN, 375 to 376.		
VALENS, GRATIAN, AND VALENTINIAN II., 376 to 378.		
GRATIAN AND VALENTINIAN II. 378 to 379.		
GRATIAN, VALENTINIAN II. AND THEODOSIUS, 379 to 383.	Maximus proclaimed Emperor in Britain	383
VALENTINIAN II. AND THEODOSIUS, 383 to 392.		
THEODOSIUS, 392 to 395.	Chrysanthus, *Vicarius*	?... *393 ... ?
ARCADIUS AND HONORIUS, 395 to 408.	Marcus, Gratian, and Constantine, successively proclaimed Emperors in Britain	407
HONORIUS AND THEODOSIUS II., 408 to 423.		

† I have thought it unnecessary to give the years of the other *Augusti* of this period.

CHEMICAL NOTES.

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On the Iodide of Barium.

Some years since the writer described the crystallised Iodide of Barium, and gave the formula, Ba I + 7 H 0. G. Werther has since examined a similar salt, but gives the formula, Ba I + 2 H 0, corresponding to the formulas of the bromide and chloride. He also describes the crystalline form as identical with that of the bromide, and states that the salt is deliquescent, and becomes reddish-brown in the air, instantaneously. He prepared the salt by acting on hyposulphite of barium with iodine, and filtering off from the tetrathionate of barium.

The writer prepared the iodide, for the former examination, by acting on baryta with iodine; but recently, by using sulphide of barium with iodine, and by Liebig's process with phosphorus. In each case the salt crystallised in long clear six-sided prisms, with flat terminal planes, no other faces could be detected. The crystals were not deliquescent in a dry atmosphere, on the contrary, they effloresced. No change of colour took place by some days exposure, farther than that they became opaque. By a strong heat iodine is evolved; but 23.61 per cent. of water can be driven out at 160° c.

The following analyses show the composition of the salt: in I. the water was determined by heating over a lamp, and is too high from loss of iodine; II. was formed from sulphide of barium; III. by means of phosphorus; and IV. is Werther's analysis, the water being calculated from the loss.

—				I.	II.	III.	IV.	V.
Barium	1	68.59	26.55	26.48	25.80	26.24	......	32.11
Iodine	1	126.88	49 08	......	48.44	48.50	......	59.46
Water	7	63.00	24.37	25.67	23.61	23.31	......	8.42
	...	258.47	100.00	......	97.85	98.05	......	......

In an attempt to form the salt by Werther's process, a small quantity was obtained, crystallising in the same form as the above, and efflorescing in the air. No salt with Werther' formula could be obtained.

On the Oxidation of Alkaline Arsenites.

Fresenius found that a solution of arsenite of potassium became rapidly oxidised, forming an arsenate, a change which would, of course, render it useless in volumetric experiments. On making some experiments on the subject, I was unable to discern the circumstances under which the strong oxidation described by Fresenius took place, as in my experiments less than one per cent. of arsenious acid was oxidised after a period of twelve months. Lately, a solution has come under my notice, in which at least twenty per cent. of the arsenious had become arsenic acid. The solution was very strong, and had deposited some of the arsenite as warty crystals. For accurate volumetric experiments it would, therefore, be advisable to examine the alkaline arsenite from time to time.

NOTES ON TRILINEARS.

In Vol. IX., No. 52, of this Journal, were given some illustrations of the use in trilinear coordinates of the equation to a line under the form

$$\frac{\alpha - f}{l} = \frac{\beta - g}{m} = \frac{\gamma - h}{n} = r,$$

where (α, β, γ) are the current coordinates, (f, g, h) the coordinates of some assumed point in the line, and r is the distance between these points.

The quantities l, m, n, being the sines of the angles between the line and the sides of the triangle of reference, when one of them is assigned the other two are determinate, and there must, therefore, exist two relations between the three. One such relation is well known to be

$$al + bm + cn = 0,$$

where a, b, c, are the sides of the triangle of reference. Another can be found as follows :—

Let $l = \sin\theta$, so that θ is the angle between the line and the side a. Then we have

$$-m = \sin(C+\theta) = \sin C\cos\theta + \cos C\sin\theta,$$
$$n = \sin(B-\theta) = \sin B\cos\theta - \cos B\sin\theta,$$

and, eliminating $\cos\theta$, $\sin\theta$, from these equations, we obtain,

$$m^2 + n^2 + 2\,mn\cos A = \sin^2 A.$$

This is one form of the relation sought for; but another form, involving all the quantities symmetrically, can readily be deduced by eliminating the product mn by aid of the first relation. Thus:

$$2\,bc\,mn = a^2l^2 - b^2m^2 - c^2n^2,$$

and, substituting this value,

$$a^2\cos A\,l^2 + b\,(c - b\cos A)\,m^2 + c\,(a - c\cos B)\,n^2 = bc\sin^2 A,$$

or,

$$\sin 2A\,l^2 + \sin 2B.\,m^2 + \sin 2C.\,n^2 = 2\sin A\sin B\sin C.$$

It is proposed to employ the above equation in the examination of the conic to which the triangle of reference is self-conjugate; viz.:

$$u\alpha^2 + v\beta^2 + w\gamma^2 = 0. \quad \ldots\ldots\ldots \quad (1).$$

1. To find the conditions that the above conic may be a circle. Cutting the circle by the line

$$\frac{\alpha - f}{l} = \frac{\beta - g}{m} = \frac{\gamma - h}{n} = r,$$

the segments of the line intercepted between (f, g, h) and the circle are the values of r in the equation.

$$(ul^2 + vm^2 + wn^2)\,r^2 + (\ldots\ldots)\,r + uf^2 + vg^2 + wh^2 = 0. \quad \ldots\ldots\ldots\ldots\ldots \quad (2).$$

If (f, g, h) be a fixed point, then, by a property of the circle, the rectangle under the segments is constant for all values of l, m, n; and, therefore,

$$ul^2 + vm^2 + wn^2 = \text{const};$$

but,

$$\sin 2A.\,l^2 + \sin 2B.\,m^2 + \sin 2C.\,n^2 = 2\sin A\sin B\sin C;$$

and, these being satisfied identically, we have

$$\frac{u}{\sin 2A} = \frac{v}{\sin 2B} = \frac{w}{\sin 2C},$$

and these are the conditions sought for.

2. To find the radius (R) of this circle:

Let the point (f, g, h) be the centre. Then

$$(ul^2 + vm^2 + wn^2) R^2 + uf^2 + vg^2 + wh^2 = 0,$$

or,

$$ul^2 + vm^2 + wn^2 = -\frac{1}{R^2}(uf^2 + vg^2 + wh^2);$$

but,

$$\frac{u}{\sin 2A} = \frac{v}{\sin 2B} = \frac{w}{\sin 2C},$$

$$= \frac{ul^2 + vm^2 + wn^2}{\sin 2A . l^2 + \sin 2B . m^2 + \sin 2C . n^2}$$

$$= -\frac{1}{R^2} \cdot \frac{uf^2 + vg^2 + wh^2}{2 \sin A \sin B \sin C}.$$

Again, (f, g, h) being the centre, we have

$$\frac{uf}{a} = \frac{vg}{b} = \frac{wh}{c}$$

$$= \frac{uf^2 + vg^2 + wh^2}{2\,\Delta}$$

Dividing the terms of the former equalities by these respectively, we have,

$$-\frac{1}{R^2} \cdot \frac{2\,\Delta}{2 \sin A \sin B \sin C} = \frac{a}{f \sin 2A} = \frac{b}{g \sin 2B} = \frac{c}{h \sin 2C}$$

$$= \frac{\dfrac{a^2}{\sin 2A} + \dfrac{b^2}{\sin 2B} + \dfrac{c^2}{\sin 2C}}{2\,\Delta}$$

and, therefore,

$$-\frac{1}{R^2} = \frac{2 \sin A \sin B \sin C}{(2\,\Delta)^2}\left(\frac{a^2}{\sin 2A} + \frac{b^2}{\sin 2B} + \frac{c^2}{\sin 2C}\right),$$

which expression is easily reduced to either of the following forms:

$$= \frac{1}{abc}(a \sec A + b \sec B + c \sec C)$$

$$= \frac{1}{2\,\Delta}(\tan A + \tan B + \tan C)$$

$$= \frac{1}{2\,\Delta}(\tan A \tan B \tan C)$$

3. To find the condition that the conic may be a rectangular hyperbola.

In this case, the equation (2) must be satisfied by the value infinity of r, for two distinct sets of values of l, m, n, and these directions are at right angles to each other. Hence

$$ul^2 + vm^2 + wn^2 = 0,$$

for two sets of values of (l, m, n); say, (l_1, m_1, n_1), (l_2, m_2, n_2), with the conditions,

$$l_1^2 + l_2^2 = 1,\ m_1^2 + m_2^2 = 1,\ n_1 + n_2^2 = 1.$$

Hence

$$ul_1^2 + vm_1^2 + wn_1^2 = 0,$$
$$ul_2^2 + vm_2^2 + wn_2^2 = 0,$$

and, by addition, we obtain

$$u + v + w = 0,$$

which is the condition sought for.

3. To discriminate the character of the conic (1).

If the conic be a hyperbola, the two sets of values of (l, m, n), which make one value of r to be infinite in equation (2) must be real; if a parabola, they must be equal; and if an ellipse, they must be imaginary. The condition of a value of r being infinite is

$$ul^2 + vm^2 + wn^2 = 0.$$

Eliminating n by aid of the relation,

$$al + bm + cn = 0,$$

we have

$$l^2 \left(u + w\frac{a^2}{c^2}\right) + m^2 \left(v + w\frac{b^2}{c^2}\right) + 2\,lm\,w\frac{ab}{c^2} = 0,$$

and the roots of this quadratic must be real, equal, or imaginary in the three cases.

Hence for the hyperbola, parabola, or ellipse, respectively, we have

$$\left(u + w\frac{a^2}{c^2}\right)\left(v + w\frac{b^2}{c^2}\right) \begin{matrix}<\\=\\>\end{matrix} 0,$$

or

$$a^2vw + b^2wu + c^2uv \begin{matrix}<\\=\\>\end{matrix} 0,$$

4. To find the axes of the conic (1).

Taking the point (f, g, h) for the centre, equation (2) gives for the value of the square of the semi-diameter (r) in any direction,

$$(ul^2 + vm^2 + wn^2)\,r^2 + uf^2 + vg^2 + wh^2 = 0,$$

which we will write for the moment,

$$ul^2 + vm^2 + wn^2 = -\frac{H}{r^2}.$$

The semi-axes being the greatest and least values of r, we must make r a maximum or minimum by the variation of l, m, n, subject to the condition

$$\begin{aligned} \sin 2A.\, l^2 + \sin 2B.\, m^2 + \sin 2C.\, n^2 &= 2\sin A \sin B \sin C \\ a\,l + b\,m + c\,n &= 0. \end{aligned}$$

Hence we obtain

$$\begin{aligned} uldl + \text{anal} + \ldots\ldots &= 0, \\ \sin 2A.\, ldl + \ldots\ldots + \ldots\ldots &= 0, \\ adl + \ldots\ldots + \ldots\ldots &= 0; \end{aligned}$$

multiplying the two latter equations by arbitraries, λ, μ, adding, and then equating to zero the coefficients of the differentials, we obtain

$$\begin{aligned} ul + \lambda \sin 2A.\, l + \mu\, a &= 0 \\ vm + \lambda \sin 2B.\, m + \mu\, b &= 0 \\ wn + \lambda \sin 2C.\, n + \mu\, c &= 0 \end{aligned}$$

Multiplying these respectively by l, m, n, and adding, we obtain

$$-\frac{H}{r^2} + \lambda.\, 2\sin A \sin B \sin C = 0,$$

or,

$$\lambda = \frac{1}{2\sin A \sin B \sin C} \cdot \frac{H}{r^2};$$

also, transposing these equations,

$$\begin{aligned} -\,l = \frac{\mu\, a}{u + \lambda \sin 2A} &= \frac{\mu \cdot \frac{a}{\sin 2A}}{\frac{u}{\sin 2A} + \lambda} \\ -\,m &= \frac{\mu \cdot \frac{b}{\sin 2B}}{\frac{v}{\sin 2B} + \lambda} \\ -\,n &= \frac{\mu \cdot \frac{c}{\sin 2C}}{\frac{w}{\sin 2C} + \lambda} \end{aligned}$$

Multiplying these respectively by a, b, c, and adding, we obtain

$$0 = \frac{\frac{a^2}{\sin 2A}}{\frac{u}{\sin 2A} + \frac{P}{r^2}} + \text{anal} + \ldots\ldots,$$

where $P = \dfrac{H}{2 \sin A \sin B \sin C}$.

To find the value of H, we have, since (f, g, h) is the centre,

$$\frac{uf}{a} = \frac{vg}{b} = \frac{wh}{c}$$

therefore

$$= \frac{uf^2 + vg^2 + wh^2}{af + bg + ch} = \frac{H}{2\,\Delta}$$

and also

$$= \frac{af + bg + ch}{\frac{a^2}{u} + \frac{b^2}{v} + \frac{c^2}{w}} = \frac{2\,\Delta}{\frac{a^2}{u} + \frac{b^2}{v} + \frac{c^2}{w}}.$$

Hence

$$H = \frac{(2\,\Delta)^2}{\frac{a^2}{u} + \frac{b^2}{v} + \frac{c^2}{w}}.$$

Hence, finally, we have the quadratic, in which the values of r^2 are the squares of the semi-axes of the conic,

$$0 = \frac{\frac{a^2}{\sin 2A}}{\frac{u}{\sin 2A} + \frac{P}{r^2}} + \text{anal} + \ldots\ ,$$

where

$$\frac{1}{P} = \frac{2 \sin A \sin B \sin C}{(2\,\Delta)^2} \left(\frac{a^2}{u} + \frac{b^2}{v} + \frac{c^2}{w}\right).$$

J. B. C.

UNIVERSITY COLLEGE,
October 25th, 1865.

CONTRIBUTIONS TO BLOWPIPE ANALYSIS.

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THE following notices comprise various blowpipe-tests and applications published by the writer within the last eighteen or nineteen years—together with two other applications of the blowpipe, published here for the first time, but already shewn to several persons interested in this method of research. Some of these tests have been appropriated by certain authors without the slightest acknowledgement; others have been incorrectly quoted; and some, again, appear to have escaped the attention of the editors of several recent works in which the applications of the blowpipe come under review. These reasons have led the writer to republish them, in the present place, in a condensed form, preparatory to the issue of an extended work on Blowpipe Practice, in which various new tests, and a large amount of other original matter, will be incorporated. This work will appear, it is hoped, early in 1866.

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1. DETECTION OF LITHIA IN THE PRESENCE OF SODA.

[*First published in the Chemical Gazette: November* 15, 1850.]

This test may be applied to mixtures of these alkalies in the simple state, or to their carbonates, sulphates, nitrates, or other compounds capable of being decomposed by fusion with chloride of barium. The test-substance, in powder, is to be mixed with about twice its volume of chloride of barium, and a small portion of the mixture is to be exposed on a loop of platinum wire to the point of a well-sustained oxidating flame. A deep-yellow coloration of the flame-border, produced by the volatilization of chloride of sodium, at first ensues. This gradually diminishes in intensity, and after a short time, a thin green streak, occasioned by chloride of barium, is seen to stream from the point of the wire, as the test-matter shrinks further down into the loop. On the fused mass being then brought somewhat deeper into the flame, the point and edge of the latter will at once assume the rich crimson tinge characteristic of the presence of lithium compounds; and the colour will endure sufficiently long to prevent the slightest chance of misconception or uncertainty. The presence of strontium compounds does not affect this reaction, as these compounds, when fused with chloride of barium, cease to impart a red color to the flame (see No. 2). In order to ensure success, or rather to avoid the least risk of failure, in the application of this test, it is only necessary to keep up a clear and sharply-defined flame for about a couple of minutes. If the red coloration do not appear by that time, the absence of lithia

—unless the latter substance be present in traces only—may be safely concluded.*

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2. METHOD OF DISTINGUISHING THE RED FLAME OF LITHIA FROM THAT OF STRONTIA.

[*First published in the Chemical Gazette: May* 1, 1848.]

It has been long known that the crimson coloration imparted to the blowpipe flame by strontia, is destroyed by the presence of baryta. This reaction, confirmed by PLATTNER—see, more especially, the *third* edition of his *Probirkunst*, page 107—was observed as early as 1829 by BUTZENGEIGER (*Annales des Mines, t.* v., *p.* 36). The latter substance, however, as first indicated by the writer, does not affect the crimson flame-coloration produced by lithia. Hence, to distinguish the two flames, the test-substance may be fused with 2 or 3 volumes of chloride of barium in a loop of platinum wire, the fused mass being kept just within the point or edge of the blue cone. If the original flame-coloration proceeded from strontia (or lime), an impure brownish-yellow tinge will be imparted to the flame-border; but if the original red colour were caused by lithia, it will not only remain undestroyed, but its intensity will be much increased.

This test may be applied, amongst other bodies, to the natural silicates, *Lepidolite*, *Spodumene*, &c. It is equally available, also, in the examination of phosphates. The mineral *Triphylline*, for example, when treated *per se*, imparts a green tint to the point of the flame, owing to the presence of phosphoric acid; but if this mineral be fused (in powder) with chloride of barium, a beautiful crimson coloration in the surrounding flame-border is at once produced.

* In testing this method, a mixture was prepared of 2 parts of ignited carbonate of soda with 1 part of carbonate of lithia, and portions of this were placed in six little porcelain capsules, distinguishing upon their undersides by a spot of ink; whilst into six similar but unmarked capsules, some carbonate of soda, only, was placed. The capsules being then arranged indiscriminately upon a tray, each was separately examined, and it was found that those which contained lithia could be separated from the rest without the slightest difficulty (November, 1850). This plan was repeated with equal success, on mixtures of 8 (NaO, CO^2) + 1 (LiO, CO^2), and 6 (NaO, CO^2) + 1 (LiO, CO^2), in May, 1865. When the lithia is in very small quantity, the blowpipe flame must not be too large.

3. DETECTION OF ALKALIES IN THE PRESENCE OF MAGNESIA.

[*First published in the Chemical Gazette : September*, 1847.]

In the analysis of inorganic bodies, magnesia and the alkalies (if present) become separated from other constituents towards the close of the operation. In continuation of the analysis, it then becomes desirable to ascertain, at once, whether magnesia is alone present, or whether the saline mass, produced by the evaporation of a portion of the solution, consists of magnesia and one or more of the alkalies, or of the latter only. By fusing a small quantity of the test-matter with carbonate of soda, the presence of magnesia is readily detected, as this substance remains undissolved; but the presence or absence of alkalies is not so easily determined, the coloration of the flame being frequently of too indefinite a character to afford any certain evidence on this point. The question may be solved, however, by the following simple process. Some boracic acid is to be mixed with the test-matter and with a few particles of oxide of copper, and the mixture is to be exposed for a few seconds, on a loop of platinum wire, to the action of an oxidating flame. In the absence of alkalies, the oxide of copper will remain undissolved; but if alkalies be present, an alkaline borate is produced, forming a readily fusible glass, in which the copper oxide is at once dissolved, the glass becoming green whilst hot, and blue when cold. If magnesia also be present, white specks remain for a time undissolved in the centre or on the surface of the bead. Any metallic oxide which imparts by fusion a colour to alkaline borates, may, of course, be employed in place of oxide of copper; but the latter has long been used in other operations, and is therefore always carried amongst the reagents of the blowpipe-case.

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4. REACTION OF MANGANESE SALTS ON BARYTA.

[*First published in Chemical Gazette : August* 1, 1846.]

When moistened with a solution of any manganese salt, and ignited in an oxidating flame, Baryta and baryta compounds, generally, assume on cooling a blue or greenish-blue colour. This arises from the formation of a manganate of baryta. Strontia and other bodies (apart from the alkalies) when treated in this manner, become brown or dark-grey. A mixture of baryta and strontia also assumes an indefinite greyish-brown colour. If some oxide of manganese be fused with carbonate of soda so as to produce a greenish-blue bead or "turquoise enamel," and some baryta or a baryta salt be melted into this, the colour of the bead will remain unchanged; but if strontia be used in place of baryta, a brown or greyish-brown enamel is produced.

NOTE :—Some examples of *Witherite, Barytine, and Baryto-calcite,* contain traces of oxide of manganese. These, after strong ignition, often assume *per se* a pale greenish-blue colour.

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5. DETECTION OF BARYTA IN THE PRESENCE OF STRONTIA.

[*First published in the Chemical Gazette : August* 1, 1846.]

This test is chiefly applicable to the detection of baryta in the natural sulphate of strontia; but it answers equally for the examination of chemical precipitates, &c., in which baryta and strontia may be present together. The test-matter, in fine powder, is to be melted in a platinum spoon with 3 or 4 volumes of chloride of calcium, and the fused mass treated with boiling water. For this purpose, the spoon may be dropped into a test-tube, or placed (bottom upwards) in a small porcelain capsule. The clear solution, decanted from any residue that may remain, is then to be diluted with 8 or 10 times its volume of water, and tested with a few drops of chromate (or bichromate) of potash. A precipitate, or turbidity, indicates the presence of baryta.

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6. ACTION OF BARYTA ON TITANIC ACID.

[*First published in Chemical Gazette :* 1852.

Fused with borax in a reducing flame, Titanic acid forms a dark amethystine-blue glass, which becomes light-blue and opaque when subjected to the flaming process. The amethystine colour arises from the presence of Ti^2O^3 : the light-blue enamelled surface, from the precipitation of a certain portion of TiO^2. The presence of baryta, even in comparatively small quantity, quite destroys the latter reaction. When exposed to an intermittent flame, the glass (on the addition of baryta) remains dark-blue, no precipitation of titanic acid taking place. Strontia acts in the same manner, but a much larger quantity is required to produce the reaction.

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7. DETECTION OF OXIDE OF MANGANESE WHEN PRESENT IN MINUTE QUANTITY IN MINERAL BODIES.

[*First published in the Philosophical Magazine: February,* 1852.]

It is usually stated in works on the Blowpipe, that the smallest traces of maganese may be readily detected by fusion with carbonate of soda, or with a mixture of carbonate of soda and nitrate of potash: but this statement is to some extent erroneous In the presence of much lime, magnesia, alumina, sesquioxide of iron, or other bodies, insoluble, or of difficult solubility, in carbonate of soda, traces of oxide of manganese may easily escape detection. By adding, however, a small portion of borax or phosphor-salt to the carbonate of soda, these bodies become dissolved, and the formation of a "turquoise enamel" (manganate of soda) is readily effected. The process may be varied by dissolving the test-substance first in borax or phosphor-salt, and then treating the fused bead with carbonate of soda: the latter being, of course, added in excess. By this treatment, without the addition of nitrate of potash, the faintest traces of oxide of manganese in limestone and other rocks, are at once made known.

NOTE:—This method of examining bodies for the presence of manganese, was recommended by *Dr. Leop. H. Fischer* in 1861 (*Leonh. Jahrbuch:* [1861] 653), but the writer had forestalled him by nine years, having already described it in 1852—a fact apparently unknown to the editor of the 4th edition of Plattner's *Probirkunst.**

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* This new edition of Plattner's treatise, although containing some valuable additions from the pen of its editor, *Dr. Theodor Richter*, is not altogether free from errors of omission. One of these, the writer may perhaps be allowed to point out on personal grounds. In the third edition, p. 273, *Plattner* states under the head of cryptolite—"Das Verhalten dieses seltenen Minerals vor dem Löthrohre ist noch nicht ermittelt." In the new edition, *Dr. Richter* expands this statement as follows:—"Kryptolit (Phosphocerit)—Das Löthrohrverhalten dieses seltenen Minerals, welches beim Auflösen des grünen and röthlichen Apatits von Arendal, sowie des gerösteten Kobaltglanzes von Johannisberg in Schweden, in Säuren zurückbleibt, ist noch nicht ermittelt." Now, the blow-

8. METHOD OF DISTINGUISHING THE MONOXIDE OF IRON (FeO) FROM THE SESQUIOXIDE (Fe^2O^3) IN SILICATES AND OTHER COMPOUNDS.

[*First published in the Chemical Gazette: March* 1, 1848.]

This test serves to indicate, with great certainty, the presence or absence of FeO in bodies generally. It is performed as follows:—A small quantity of black oxide of copper (CuO) is dissolved in a bead of borax on platinum wire, so as to form a glass which exhibits, on cooling, a decided blue colour, but which remains transparent. To this, the test-substance in the form of powder is added, and the whole is exposed for a few seconds, or until the test-matter begins to dissolve, to the point of the blue flame. If the substance contain Fe^2O^3 only, the glass on cooling will remain transparent, and will exhibit a blueish-green colour. On the other hand, if the test-substance contain FeO, this will become at once converted into Fe^2O^3 at the expense of some of the oxygen of the copper compound; and opaque red streaks and spots of Cu^2O will appear in the glass, as the latter cools.*

NOTE:—Although this test is quoted by Plattner—perhaps the best criterion of its accuracy—it is passed over, without mention, in many works on chemical analysis. The writer may therefore be allowed to call to mind, in proof of its efficacy, that by its use in 1848 he pointed out the presence of FeO in the mineral *Staurolite* (*Chem. Gaz., July* 15, 1848; see also *Erdmann's Journal für pract. Chem.*, XLVI., 119), nearly thirteen years before this fact—now universally admitted—was discovered and announced by *Rammelsberg* (*Berichte d. Kongl. preuss. Akad. d Wiss. zu Berlin: Marz*, 1861.)

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pipe characters of Phosphocerite were given in a paper on that mineral, published in the journal of the Chemical Society of London in 1848; and these characters are referred to, from the paper in question, in the third volume of *Henry Watt's* English translation of *Gmelin's Handbuch*, published by the Cavendish Society in 1849, as well as in both the third and fourth editions of *Dana's* System of Mineralogy.

* Provided too much copper oxide be not dissolved in the glass—so as to become reduced *per se*—this test may be performed with either a reducing or an oxidating flame. If the method be tried with a few bodies of known composition (in some of which FeO is present, and in others absent) the operator will see, at once, that it offers no risk of failure—always assuming, of course, the absence of other reducing bodies, a point easily ascertained by the blowpipe,

9. DETECTION OF MINUTE TRACES OF COPPER IN IRON PYRITES AND OTHER BODIES.*

Although an exceedingly small per-centage of copper may be detected in blowpipe experiments, by the reducing process, as well as by the azure-blue coloration of the flame when the test-matter is moistened with chlorhydric acid, these methods fail in certain extreme cases to give satisfactory results. It often happens that veins of Iron Pyrites lead at greater depths to Copper Pyrites. In this case, according to the experience of the writer, the Iron Pyrites will almost invariably hold minute traces of copper. Hence the desirability, on exploring expeditions, more especially, of some ready test, by which, without the necessity of employing acids or other bulky and difficultly portable reagents, these traces of copper may be detected.† The following simple method will be found to answer the purpose :—The test-substance, in powder, must first be roasted on charcoal, or, better, on a fragment of porcelain,‡ in order to drive off the sulphur. A small portion of the roasted ore is then to be fused on platinum wire with phosphor-salt ; and some bisulphate of potash is to be added to the glass (without this being removed from the wire) in two or three successive portions, or until the glass becomes more or less saturated. This effected, the bead is to be shaken off the platinum loop into a small capsule, and treated with boiling water, by which either the whole or the greater part will be dissolved ; and the solution is finally

* This method has not been hitherto published ; but it is inserted here, as it has been shown to various persons interested in blowpipe experiments. The same remark applies to No. 11.

† In Blowpipe Practice—as far, at least, as this is possible—the operator should make it an essential aim to render himself independent of the use of mineral acids and other liquid and inconvenient reagents of a similar character. If these reagents cannot be dispensed with altogether, their use, by improved processes, may be greatly limited.

‡ In the roasting of metallic sulphides, &c., the writer has employed, for some years, small fragments of Berlin or Meissen porcelain, such as result from the breakage of crucibles and other vessels of that material. The test-substance is crushed to powder, moistened slightly, and spread over the surface of the porcelain ; and when the operation is finished, the powder is easily scraped off by the point of a knife-blade or small steel-spatula. In roasting operations, rarely more than a dull red heat is required ; but these porcelain fragments may be rendered white-hot, if such be necessary, without risk of fracture. *Canadian Journal*, September, 1860.

to be tested with a small fragment of ferrocyanide of potassium ("yellow prussiate.") If copper be present in more than traces, this reagent, it is well known, will produce a deep red precipitate. If the copper be present in smaller quantity, that is, in exceedingly minute traces, the precipitate will be brown or brownish-black; and if copper be entirely absent, the precipitate will be blue or green—assuming, of course, that Iron Pyrites or some other ferruginous substance is operated upon. In this experiment, the preliminary fusion with phosphor-salt greatly facilitates the after solution of the substance in bisulphate of potash. In some instances, indeed, no solution takes place if this preliminary treatment with phosphor-salt be omitted.

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10. DETECTION OF LEAD IN THE PRESENCE OF BISMUTH.

[*First published in the Chemical Gazette: Sept.* 15, 1848.]

When Lead and Bismuth are present together, the latter metal may be readily detected by its known reaction with phosphor-salt in a reducing flame—antimony, if present, being first eliminated; but the presence of lead is less easily ascertained. If the latter metal be present in large quantity, it is true, the metallic globule will be more or less malleable, and the flame-border will assume a clear blue color when made to play upon its surface, or on the sublimate of lead-oxide as produced on charcoal; but in other cases, this reaction becomes exceedingly indefinite. The presence of lead may be detected, however, by the following plan, based on the known reduction and precipitation of salts of bismuth by metallic lead: a method which succeeds perfectly with brittle alloys containing 85-90 per cent. of bismuth. A small crystal or fragment of nitrate of bismuth is placed in a porcelain capsule, and moistened with a few drops of water, the greater part of which is afterwards poured off; and the metallic globule of the mixed metals, as obtained by the blowpipe, having been slightly flattened on the anvil until it begins to crack at the sides, is then placed in the midst of the sub-salt of bismuth formed by the action of the water. In the course of a minute or even less, according to the amount of lead that may be present, an arborescent crystallization of metallic bismuth will be formed around the globule.

This reaction is not affected by copper; but a precipitation of bismuth would ensue, in the absence of lead, if either zinc or iron were present. These metals, however, may be eliminated from the test-globule by exposing this on charcoal for some minutes, with a mixture of carb-soda and borax to a reducing flame. The zinc becomes volatilized, and the iron is gradually taken up by the borax. If a single operation do not effect this, the globule must be removed from the saturated dark green glass, and treated with further portions of the mixture, until the resulting glass be no longer colored.

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11. DETECTION OF ANTIMONY IN TUBE-SUBLIMATES.

In the examination of mineral bodies for antimony, the test-substance is often roasted in an open tube for the production of a white sublimate. The presence of antimony in this sublimate may be detected by the following process—a method more especially available when the operator has only a portable blowpipe-case at his command. The portion of the tube to which the chief part of the sublimate is attached, is to be cut off by a triangular file, and dropped into a test-tube containing some tartaric acid dissolved in water. This being warmed or gently boiled, a part at least of the sublimate will be dissolved. Some bisulphate of potash—either alone, or mixed with some carb-soda and a little borax, the latter to prevent absorption—is then to be fused on charcoal in a reducing flame; and the alkaline sulphide thus produced, is to be removed by the point of the knife-blade, and placed in a small porcelain capsule. The hepatic mass is most easily separated from the charcoal by removing it before it has time to solidify. Some of the tartaric acid solution is then to be dropped upon it, when the well known orange-colored precipitate of $Sb\,S^3$ will at once result.

In performing this test, it is as well to employ a somewhat large fragment of the test-substance, so as to obtain a thick deposit in the tube. It is advisable also to hold the tube in not too inclined a position, in order to let but a moderate current of air pass through it; and care must be taken not to expose the sublimate to the action of the flame—otherwise it might be converted almost wholly into a compound of $Sb\,O^3$ and $Sb\,O^5$, the greater part of which would remain undissolved in the tartaric acid solution. A sublimate of arsenious acid, treated in this manner, would, of course, yield a yellow precipitate, easily distinguished by its color, however, from the deep orange antimonial sulphide. The crystalline character, etc., of this sublimate, would also effectually prevent any chance of misconception.

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12. THE COAL ASSAY.

[*First published in the Canadian Journal: May, 1858; and in the Philosophical Magazine for July of that year.*]

In the practical examination of Coals, the following operations are essentially necessary:*—(1) The estimation of the water or hygro-

* To these might be added, the determination of the heating powers or "absolute warmth" of the coal, but this may always be estimated with sufficient exactness for practical purposes by the amount of coke, ash, and moisture, as compared with other coals. Properly considered, the litharge test, resorted to for the determination of the calorific power of coals, is of very little actual value. The respective results furnished by good wood charcoal and ordinary coke, for example, are closely alike, if not in favour of the charcoal; and yet experience abundantly proves the stronger heating powers of the coke. In practice, moreover, the actual value of a coal does not always depend upon the "absolute warmth" of the latter, as certain coals, such as brown coals rich in bitumen, may possess heating powers of considerable amount (as estimated by the reduction of litharge) though only of brief duration. Thus, the lignites of the department of the Basses Alpes in south-eastern France, and those of Cuba, yield with litharge from 25 to 26 parts of reduced lead; whilst many caking coals, practically of much higher heating power, yield scarcely a larger amount. When pyrites also is present in the coal—a condition of very common occurrence—the litharge test becomes again unsatisfactory, the pyrites exerting a reducing action on the lead compound.

As described, however, by Bruno Kerl, in quoting the writer's Coal Assay (*Löthrohr-Untersuchungen: Zweite Aufl.* 1862, p. 146) the so-called absolute warmth or heating power of a coal sample may be determined, if desired, in blowpipe practice, by the following modification of Berthier's method:—20 milligrammes of the coal, in fine powder, are to be mixed intimately with 500 milligrammes of oxy-chloride of lead (consisting of 3 parts of litharge + 1 part of chloride of lead, fused together and finely pulverized). The mixture is to be placed in a blowpipe-crucible, and covered with about an equal amount of the lead compound, a second cover of 8 blowpipe-spoonfuls of powdered glass + 1 spoonful of borax, being spread over this. The crucible, covered with a clay capsule, is then to be fitted into a charcoal block in the ordinary blowpipe furnace, over which a charcoal lid is placed, and the flame directed against its under side, so as to keep it at a red heat for from 5 to 8 minutes. The weight of the reduced lead divided by 20 gives the amount of the lead mixture reduced metric moisture present in the coal; (2) the determination of the weight and character of the coke; (3) the estimation and examination of the ash or inorganic matters; and (4) the estimation of the sulphur, chiefly present in the coal as FeS^2.

Estimation of Moisture:—This operation is one of extreme simplicity. Some slight care, however, is required to prevent other volatile matters from being driven off during the expulsion of the moisture. Seven or eight small particles, averaging together from 100 to 150 milligrammes, are to be detached from the assay specimen by means of the cutting pliers, and carefully weighed. They are then to be transferred to a porcelain capsule with thick bottom, and strongly heated for four or five minutes on the support attached to the blowpipe lamp, the unaided flame of the lamp being alone employed for this purpose. It is advisable to place in the capsule, at the same time, a small strip of filtering or white blotting-paper, the charring of which will give indications of the temperature becoming too high. The coal, whilst still warm, is then to be transferred to the little brass capsule in which the weighings are performed, and its weight ascertained. In transferring the coal from one vessel to the other, the larger pieces should be removed by a pair of fine brass forceps, and the little particles or dust afterwards swept into the weighing capsule by means of the camel's-hair pencil or small colour-brush belonging to the balance-case. The weighing capsule should also be placed in the centre of a half-sheet of glazed writing-paper, to prevent the risk of any accidental loss during the transference. After the weighing, the operation must always be repeated, to ensure that no further loss of weight occur. In place of the blowpipe-lamp, the spirit-lamp may be employed for this operation; but, with the former, there is less danger of the heat becoming too high. By holding a slip of glass for an instant, every now and then, over the capsule, it will soon be seen when the moisture ceases to be given off. It should be remarked, that some anthracites decrepitate slightly when thus treated, in which case the porcelain capsule must be covered at first with a small watch-glass.

In good samples of coal, the moisture ought not to exceed 3 or 4 per cent., but in coals that have been long exposed to damp it is often

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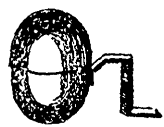
by 1 part of the coal. One part of pure carbon reduces 34 parts of this mixture; one part of charcoal, 30–33 parts; one part of bituminous coal, 19–33; one part of brown coal, 14–26; one part of peat, 8–27; and one part of wood, 12–15 parts.

as high as 6 or 7, and even reaches 15 or 20 per cent. in certain lignites. Where large quantities of coal are consumed, therefore, a serious loss is entailed on the purchaser unless the moisture be properly determined and allowed for.

Estimation, &c., of Coke:—In this operation, a small crucible of platinum is most conveniently employed. This may consist of a couple of rather deep spoons—the larger one without a handle, so as to admit of being placed over the smaller spoon, as in the annexed figure: thus serving as a lid. The long handle of the crucible-spoon must be bent as shown in the drawing, in order that the spoon may retain an upright position when placed on the pan of the balance.



The spoon-crucible of this kind employed by the writer, weighs (with its lid) only 2.33 grammes, or rather less than 36 grs. About 150 milligrammes of coal are detached as before, in several small fragments, from the assay-specimen. These may be weighed directly in the crucible, the latter being placed in the little weighing capsule of horn or brass, with its handle-support projecting over the side of this. The crucible, with its cover on, is then taken up by a convenient forceps (see the note on page 19) and brought gradually before the blowpipe to a red heat. The escaping gases will take fire and burn for a few seconds around the vessel, and a small amount of carbonaceous matter may be deposited upon the cover. This rapidly burns off, however, on the heat being continued. As soon as it disappears, the crucible is to be withdrawn from the flame, and placed on the blowpipe-anvil to cool quickly. Its weight is then ascertained: always without removing the cover. The loss, minus the weight of moisture as found by the first process, gives the amount of volatile or gaseous matter. The residue is the coke and its contained ash. The coke in some anthracites exceeds 89 or 90 per cent. In anthracitic or dry coals it usually varies from 70 to 80 per cent., and the fragments are sometimes slightly agglutinated. In ordinary bituminous or caking coals, it amounts in general to about 65 or 70 per cent., and presents a fused and mamillated surface. In cannel or gas coals, the per centage of coke may be assumed to equal 50 or 60, but it is sometimes as low as 30. The coke fragments are often partially agglutinated, but they never present a fused, globular aspect. Finally, in lignites or brown coals, the coke may vary from 25 to 50 per cent. It forms sharp-edged fragments of a dull charcoal-like appearance, without any signs of fusion.

Estimation of Ash or Inorganic Matters :—A platinum capsule is employed for this operation. One of about half an inch in diameter, with a short ear or handle, is sufficiently large. A somewhat smaller capsule, with its handle cut off, may be fitted into this (in reversed position) to serve as a lid. The weight of the two together need not exceed $2\frac{1}{2}$ or $2\frac{3}{4}$ grammes.* The coal must be reduced to a coarse powder, and about 150 milligrammes weighed out for the experiment. The platinum capsule is then to be fixed in a slightly-inclined position above the spirit-lamp, and heated as strongly as possible. If the wick of the spirit-lamp be raised sufficiently, and the capsule be light and thin, the temperature will be sufficient to burn off the carbon: at least, in the majority of cases. The lid of the capsule must be placed above the coal powder until combustion cease, and all the more gaseous products are driven off, as otherwise, a portion of the powder might very easily be lost. During the after combustion, the powder must be gently stirred, and if agglutination take place, the particles must be carefully broken up, by a light steel-spatula or by a piece of stout platinum-wire flattened at one end. If the carbonaceous matter be not burnt off by this treatment, the blowpipe may be used to acce-

* It is convenient to have counterpoises for the platinum vessels described above, as the weights which accompany the blowpipe-balance only range, in general, from a gramme downwards. A small platinum capsule forms an excellent counterpoise. It can be trimmed down by a pair of fine scissors until brought by repeated trials to the proper weight. The writer has cut out receptacles for two platinum vessels and counterpoises of this kind, in the little box into which his travelling balance packs; and he recommends other operators to do the same, as these vessels are of very convenient use, not only in coal assaying, but in ascertaining the amount of water in minerals, as well as for other purposes.

These platinum vessels are held most conveniently, during ignition, by a pair of steel forceps, of the annexed pattern, so constructed as always to remain closed at the points except when subjected to pressure. With forceps of this kind, the vessels in question may be taken up and disengaged in an instant, without the intervention of the right hand. The forceps may be laid down also, whilst the vessels are red hot, without risk of the latter coming in contact with the table.

lerate the process; but the operator must blow cautiously, and direct the flame only against the under side of the capsule, in order to avoid the risk of loss. Finally, on the ash ceasing to exhibit in any of its particles a black color, the lid of the capsule is to be carefully replaced, and the whole cooled and weighed.*

In good coals, the amount of ash is often under 2 per cent., and it rarely exceeds 4 or 5 per cent. In coals of inferior quality, however, it may vary from 8 or 10 to even 20 per cent. As regards its composition, the ash may be:—(1) argillaceous, consisting essentially of a silicate of alumina; (2) argillo-ferruginous; (3) calcareous; and (4) calcareo-ferruginous. If free from iron, it will be white or pale grey; but if more or less ferruginous, it will present a red, brown, or yellowish color. Phosphor-salt, so useful in general cases for the detection of siliceous compounds, cannot be safely used to distinguish the nature of the ash obtained in blowpipe assays. Owing to their fine state of division and to the small quantity at command, argillaceous ashes dissolve in this reagent with as much facility as those of a calcareous nature, and without producing a characteristic silica skeleton, or causing the opalization of the glass. With calcareous ashes also, the amount obtained is rarely sufficient to saturate even an exceedingly minute bead of phosphor-salt or borax, and hence no opacity is produced by the flaming process. The one kind of ash, may be distinguished, nevertheless, from the other, by moistening it, and placing the moistened mass on reddened litmus-paper. Calcareous ashes always contain a certain amount of caustic lime, and thus restore the blue color of the paper. These calcareous ashes, also, though principally composed of carbonate of lime, sometimes contain small portions of phosphate and sulphate of lime. The presence of the latter may be readily detected by the well known production of an alkaline sulphide by fusion with carbonate of soda in a reducing flame—the fused mass exhibiting a reddish color, and imparting when moistened a dark stain to a plate of silver or piece of lead test-paper. The latter may

* If the ash be very ferruginous—in which case it will present a red or tawny color—the results, as thus obtained, will require correction: the original iron pyrites of the coal being weighed as sesquioxide of iron. In ordinary assays, however—as distinguished from analyses—this may be fairly neglected. When also the ash happens to be calcareous and to occur in large quantity, it should be moistened with a drop or two of a solution of carbonate of ammonia, and gently heated, previous to being weighed.

be replaced by a glazed visiting-card. In examining earthy sulphates by this method, a little borax ought always to be added to the carbonate of soda, in order to promote the solution of the test-matter. If oxide of manganese be present in the ash, the well-known manganate of soda, or "turquoise enamel," will also be obtained by this treatment.

Estimation of Sulphur:—The following plan is perhaps the most simple that can be employed for the determination of sulphur in coal samples. It is merely an adaptation to blowpipe practice of the process very generally employed for that purpose:—

As large an amount of coal as practicable, several pounds at least, taken from different parts of the same heap or bed, must be broken into powder and well stirred together. About 150 milligrammes are to be weighed out for the assay. This amount is to be intimately mixed with about 450 milligrammes of nitrate of potash and an equal quantity of carbonate of potash, and the mixture, with a good covering of salt, is to be fused in a small platinum crucible of about a quarter of an ounce capacity. The crucible may be fixed in an ordinary blowpipe-furnace, in the centre of an already used charcoal-block, as the cavity of the latter will require to be larger than usual. The heat at first must be very moderate, as the mixture swells up greatly; but after a couple of minutes, or thereabouts, a tolerably strong blast may be kept up for from two to three minutes in addition, when the operation will be finished. The alkaline sulphate, thus produced, is dissolved out by boiling water, and the solution, acidified by a few drops of chlorhydric acid, is then treated with chloride of barium. The weight of the precipitate divided by 7.28 gives the amount of sulphur. An ordinary blowpipe crucible of clay may be employed for this operation; but it is always strongly attacked by the mixture during fusion, and is otherwise less convenient for the purpose than one of platinum.

When the iron pyrites in the coal is not in a state of semi-decomposition, its amount, and consequently the amount of sulphur, may be arrived at far more nearly than might at first thought be supposed, by the simple process of washing in the agate mortar. Each single part of pyrites corresponds to 0·533 of sulphur. Several large pieces of the assay-coal should be taken, and broken up into powder, and a couple of trials should be made on separate portions of this. About 500 milligrammes may be taken for each trial, and washed in three or four portions. In the hands of one accustomed to the use of the mortar in reducing experiments, the results, owing to the lightness of the coal particles, and the consequent ease with which they are floated off, come out surprisingly near to the truth. In travelling, we may dispense with the washing bottle, by employing, in its place, a piece of straight tubing drawn out abruptly to a point. This is to be filled by suction, and the water expelled with the necessary force by blowing down the tube. A tube 6 inches long and the fourth of an inch in diameter, will hold more than a sufficient quantity of water to be used between the separate grindings.* The mortar should be but slightly inclined, and the stream of water must not be too strong; otherwise, especially if the coal be ground up very fine, portions of the pyrites may be lost. The proper manipulation, however, is easily acquired by a little practice.

A Monograph on the British Spongiadæ. By J. S. Bowerbank, LL.D., F.R.S., F.L.S., F.G.S., F.Z.S., F.R.A.S., &c., &c. Vol. I., 1864.

AMONG recent contributions to Zoological science, a high place must be assigned to Dr. Bowerbank's researches respecting the Sponges. On occasion of the completion of his papers laid before the Royal Society we referred to the interest belonging to them, and gave a slight notice of his mode of arrangement, (vide Canadian Journal, vol. VII., p. 468). We would now direct the attention of our readers to the portion already published of his valuable monograph on the British Spongiadæ issued by the Ray Society. If he had chiefly occupied himself in this work with the characters and history of the genera and species occurring on the British coasts we should not have thought it likely to interest many in a country where the objects could rarely, if ever, be seen, even as preserved specimens in a museum, and where anything at all similar can rarely be found; but as the volume now before us is devoted to the anatomy and physiology of the Spongiadæ, a subject both curious and novel, which cannot fail to prove attractive to all lovers of nature, we have thought that any information we can

* In the third edition of his *Probirkunst*, p. 60, PLATTNER alludes to the use of a tube of this kind, as a make-shift for the washing bottle, in reducing operations; but in the new edition, this reference to its use is omitted.

give in the space at our disposal would prove generally acceptable, and might lead some to the study of an original, instructive, and beautiful book.

The Spongiadæ should be regarded as a class of the subkingdom Protozoa, occupying an intermediate position between the Ciliata, or Infusoria, as that term is now limited, and the Rhizopoda, which may justly be regarded as exhibiting the lowest type of animal life. The Spongiadæ have been by many, and are still by a few, referred to the vegetable kingdom, but the characteristics of animal life are too plainly manifested by them for it to be easy, in consideration of what is now known of their structure, to resist the evidence which places them as not even the lowest of animals. If the true sponges are alone kept in view, Dr. Grant's name, Porifera, may seem most appropriate, but we cannot resist the inclination to place the Thallassicollidæ certainly, and the Gregarinidæ probably, in the same class, in which, (unlike the Rhizopoda,) whether single or associated in masses, each animalcule is enclosed by a special membrane or skin, but there is no oral or other definite aperture, the least possible differentiation of internal parts, and when there are cilia they are used to create currents through openings in a complex mass of animalcules, not for the purpose of individual locomotion. With this view of the class the name Porifera loses its applicability and another seems to be required, for still stronger objections lie against DeBlainville's name, Amorphozoa. We adopt Professor Reay Greene's definition of the highest class of Protozoa, which we prefer to call Ciliata rather than Infusoria, the latter term having been used very vaguely, and conveying no distinctive meaning. *Ciliata are animals belonging to the subkingdom Protozoa, provided with a mouth and rudimentary digestive apparatus; their bodies usually consisting of three distinct layers, the outer of which is, in most cases, furnished with a variable number of Cilia.* Rhizopoda may, we think, be defined: *Animals belonging to the subkingdom Protozoa, often contained in a hard enclosure of variable substance, but never having a differentiated skin or cilia; usually, perhaps constantly, with a nucleus, but with no other permanent distinction of parts; taking their food by protrusion of the sarcode which forms their substance so as to enclose the prey, and performing any movements of which they are capable by the same means, these protrusions being called pseudopodia.* Between these two classes comes in that of which we are now treating, and which we are disposed to define as follows: *Animals be-*

longing to the subkingdom Protozoa, having a more or less distinctly differentiated skin, sometimes furnished with cilia, and a nucleus, but with no other distinction of parts; generally associated in masses, the common body being strengthened by hard parts which are usually spicula; nutrition always by absorption of dissolved animal and vegetable matter through the skin, there being neither mouth nor power of enclosing prey. It is the view here presented of sponge structure, supposing a sponge to be not an animal but a colony of closely united animals, partaking in a common life and common plans for figure, aeration and nutrition, each so-called amæbiform cell being a unicellular animal, one individual of the colony, which seems to us to justify the connection of the Thalassicollidæ, and even the Gregarinidæ, with Spongiadæ, as members of the same class, and taking the nutrition by absorption as the most peculiar characteristic we would propose for the class the name RHOPETICA.*

Dr. Bowerbank appears to us to treat the whole sponge as an animal, and the sarcode lining, composed of cells, which we consider as the animalcules, as being its digestive system. There are no doubt facts connected with the differences in different parts of sponges, and with their reproductive system which seem to favour this view, though we think them reconcilable with what we have proposed. But, leaving questions of this kind for the present, and limiting our attention to the true Sponges, which alone form the subject of Dr. Bowerbank's work, we will endeavour to collect some interesting particulars respecting their organization.

If a reader to whom the subject is altogether novel will inspect a piece of the sponge of commerce, he will observe that it consists of a flexible horny substance, seen with a magnifier to consist of a fine net-work of inosculated fibres, presenting everywhere minute pores on its surface, and having much larger openings scattered at intervals or raised on elevations above the general surface. He understands that this sponge has been cleaned from its animal matter, which consisted of sarcode (the animal substance of Protozoa—an homogenous animated jelly,) covering all the fibres so as to form a lining to the chan-

* From the Greek 'Ροφέω, *absorbeo*, "animals living by absorption." Should the writer's view of the nature of Sponges be admitted, the new name is wanted, and he hopes will be found unobjectionable. If each Sponge is an individual animal, Dr. Grant's name Porifera should not be superseded. In that case I have nothing to suggest, respecting the affinities of Thalassicollidæ or Gregarinidæ.

nels, but really made up of distinct cells, each having its own covering. A little inquiry will show that the sarcode is the constant feature whilst the skeleton may have its strength and figure given by siliceous or calcareous spicules, or even by regularly disposed particles of sand. It is found that water is absorbed by the smaller and more numerous openings, and forced along in currents which are believed to depend on the action of the cilia on some at least of the cells forming the lining, which water as it passes affords both aeration and nutrition to the cells, and is finally discharged through the larger openings called oscula. It is found, also, that certain specialized cells produce the reproductive elements, the matured ova being conveyed down the channels through which also gemmules which have budded out on the surface are carried forth to found new colonies. This is a general statement of what is known of the life of sponges and is common to them all. It will enable any one to understand the particulars which we have selected for notice. In the organization of sponges the spicula claim especial attention, and although their various forms have been favourite objects with the microscopist, the variety in their functions and the relations in which the different kinds occur in the same species, have chiefly become known through Dr. Bowerbank's labours. He divides the spicula primarily into 1. The essential skeleton spicula; 2. The auxiliary spicula. Of the former he speaks thus:—

"In the siliceous sponges they are usually simple, elongate in form, slightly curved, and occasionally more or less furnished with spines. They are either irregularly matted together, collected in fasciculi, or dispersed within or upon the keratose fibres of which the skeleton is to a great extent composed. Occasionally, but not frequently, they assume the triradiate form. In the calcareous sponges, beside the simple elongate form, the triradiate spicula are found in abundance.

"All the elongate forms of spicula of the skeleton are subject to extreme variety in length. In some species they maintain a great degree of uniformity, while in others they vary to a very considerable extent according to the necessities arising from the mode of the construction of the skeleton. When the areas of the reticulations are large, they are generally long and rather stout, and are usually shorter when the proportions of the network are small and close. When enclosed in keratose fibre, they are most frequently smaller and shorter in their proportions than those in the Halichondroid sponges. And in those species in which they are dispersed over the membranous tissues, as in *Hymeniacidon*, Bowerbank, they are generally long, slender, and frequently flexuous. In the sponges of this structure having siliceous spicula the triradiate form of spiculum occurs but rarely, while in the calcareous sponges, which consist of membranes and dispersed spicula, the triradiate forms of skeleton spicula are the normal ones.

"When the skeleton is constructed of large fasciculi of spicula, as in *Tethea* and

Geodea, they attain their greatest dimensions as essential spicula of the skeleton, frequently exceeding the eighth of an inch in length.

"The greatest known length of spicula occurs in the prehensile ones of *Euplectella aspergillum* and *cucumer*, Owen, where they are found to exceed three inches in length; and in *Hyalonema mirabilis*, Gray, where in the spiral column of the great cloacal appendage they reach the extreme dimensions of six ar seven inches in length; but in both these cases the spicula must be considered as auxiliary, and not essential forms.

"The larger number of forms of skeleton spicula are perfectly smooth, but in some species they are partially or entirely covered with spines.

"In every case they appear in the living state to have the capability of a change of position within the fibre to a considerable extent, in accordance with the natural alterations arising from the extensions or contractions of those tissues.

"The spicula are among the earliest developed organs of the sponge. Dr. Grant, in his valuable 'Observations on the Structures and Functions of the Sponge,' published in the 'Edinburgh New Philosophical Journal,' vol. I. p. 154, states that spicula are developed in the locomotive gemmules of *Halichondria panicea*, (*Hal. incrustans*, Johnston,) before they attach themselves for life and commence their development as fixed sponges. And in the gemmules of *Tethea cranium* they are abundantly developed even before the gemmules are detached from the parent, and some of them are forms peculiar to the gemmule.

"The growth of the spicula and their mode of extension appears to vary according to circumstances. Thus an acerate spiculum is at first short and very slender; as the dev- nent proceeds it increases in diameter, and appears to lengthen equally from the middle towards both ends; but in spinulate ones the increase in length does not appear to be effected in the same manner as in the acerate form, as we often find spinulate spicula fully developed at the base, while the shaft is exceedingly short and the apical termination hemispherical instead of acutely pointed, as in the adult state. As the shaft lengthens towards its full proportions, it attenuates; but in all the intervening stages the apical termination is usually more or less hemispherical."

His general account and subdivision of the auxiliary spicula is as follows:—

"Beside the spicula essential to the structure of the skeleton, there are several other forms of these organs, many of which, although not absolutely necessary in the structure of the skeleton, are of very frequent occurrence in subsidiary organs found in peculiar species and in particular genera. They may be conveniently classed under the following heads:

Connecting spicula.
Prehensile spicula.
Defensive spicula.
Tension spicula.
Retentive spicula.
Spicula of the sarcode.
Spicula of the ovaries and gemmules.

"In the above designations of the auxiliary spicula, it must not be understood that their respective titles strictly define their offices, as it frequently occurs that under peculiar circumstances the same form of spiculum is destined to serve two, or even three, distinct purposes Thus, an external defensive spiculum will occasionally perform retentive offices for the purpose of securing prey; or internal defensive spicula will combine the offices of defensive spicula against the larger and more powerful of their enemies with that of wounding and securing their smaller ones."

It would lead us much too far to give particulars of the various and often wonderful forms which occur under the several heads here indicated. It was a very happy idea, the division of all the true sponges into three groups, according to the substance which forms their skeleton. These Dr. Bowerbank denominates Calcarea, Silicea and Keratosa. In the first two the skeleton is strengthened by the hard parts of which we have given some account; in the third it is composed of a peculiar substance, of the nature of which we will now give our author's statement :—

"Keratode is the substance of which the horny elastic fibres of the skeleton of the officinal sponges of commerce are composed. It has, correctly speaking, no relationship either chemically or structurally with horn, and Dr. Grant has judiciously rejected the term 'horny fibre' as applied to the sponges of commerce, and has substituted that of keratose by way of distinction; and in accordance with that term I propose to designate the substance generally as keratode. whether it occurs in the elastic fibrous skeleton of true *Spongia*, which are composed almost entirely of this substance, or of those of the Halichondraceous tribe of Spongiadæ, where it is subordinate to the spicula in the construction of the skeleton, and appears more especially in the form of an elastic cementing medium. In a dried state in is often rigid and incompressible, but in its natural condition it is more or less soft, and always flexible and very elastic. It varies in colour from a very light shade to an extremely deep tint of amber, and it is always more or less transparent. In its fully developed condition, in the form of fibre, it appears always to be deposited in concentric layers; but in the mode of the development of these layers there are some interesting variations from the normal course of production. As we find in *Aranea diadema*, the common Garden Spider, that the creature has the power of modifying the deposit of the substance of its web so that the radiating fibres dry rapidly while the concentric ones remain viscid for a considerable period, so we find in the production of the young fibres of the skeletons of the Spongiadæ in some species, as in those of commerce, there is no adherent power at the apex of the young fibre, excepting with parts of its own substance; while in *Dysidea*, and in some other genera, the apex of the newly-produced fibre is remarkably viscid, adhering with great tenacity to any small extraneous granules that it may happen to touch in the course of its extension (Fig. 272, Plate XIV); but this adhesive character appears to be confined to the earliest stages of its production only, as exhibited at the apices of the newly-produced fibres, the external surface immediately below the apex exhibiting no subsequent adhesive property.

"Lehman, in his 'Physiological Chemistry,' Cavendish Society's edition, vol. I. p. 401, states that *Spongia officinalis* of commerce consists of 20 atoms of fibroin, 1 atom of iodine, and 5 atoms of phosphorus; and in treating of the physiological relations of fibroin as regards sponges, he observes: 'Its chemical constitution affords one of the arguments why the *Spongia* should be classed among animals and not among plants, since in the vegetable kingdom we nowhere meet with a substance in the slightest degree resembling fibroin.'"

Elsewhere he enumerates the following nine varieties of keratose skeleton fibre:

1. Solid simple keratose fibre.
2. Spiculated keratose fibre.
3. Hetro-spiculated keratose fibre.
4. Multi-spiculated keratose fibre.
5. Inequi-spiculated keratose fibre.
6. Simple fistulose keratose fibre.
7. Compound fistulose keratose fibre.
8. Regular arenated keratose fibre.
9. Irregularly arenated keratose fibre.

We cannot here enter at length on Dr. Bowerbank's speculations respecting the sarcode substance of sponges. He considers it as not merely the principal material of the body of Protozoa, but as closely related (if not identical) to the mucous lining of the intestine in the higher animals and the corresponding substance throughout the animal kingdom, but he views it as a whole as the most vital portion of each sponge. We have already stated our belief that we are to consider each insulated sarcode cell as an animalcule and the mass of the sponge as a great colony, the membranes and hard parts of which are to be compared with the common parts of Hydroids among Acalephæ, and of such Polypifera as Alcyoniums and Gorgoniads. According to this view the individual animalcule differs from an Amæba in being a cell enclosed by a membrane and nourished by absorption, and hence we denominate the class as *animals living by absorption*, and in the division of the Protozoan subkingdom which only admits of the lower three out of the five tendencies of development observable in the animal kingdom, we place this class as second of the three, or as corresponding to the fourth position in which an anomalous mode of obtaining food, frequently suctorial or extractive, is a characteristic. We do not apprehend that this difference as to the theoretical nature of a sponge is opposed by any of Dr. Bowerbank's facts, or would cause any but verbal changes in his statements. We regard the channels through a sponge as bearing some analogy to the central channel of a colony of Pyrosomata, though exhibiting a much more complicated structure. The nature and use of these channels are explained in the following passage by our author: —

"THE INTERSTITIAL CANALS AND CAVITIES.

"These organs exhibit their most complete mode of development in the genus *Spongia* and in the Halichondroid sponges, occupying nearly the whole of the masses of the animals. They consist of two distinct systems, an incurrent and an excurrent one. The incurrent series have their origin in the intermarginal cavities immediately within the dermal membrane, and their large open mouths receive from these organs the water inhaled through the pores, and convey it to the inmost depths of the sponge, ramifying continually like arteries as they proceed in their course downward, until they terminate in numerous minute branches. The inhaled fluid is then taken up by the minute commencements of the excurrent series, which continually unite as they progress towards the surface of the sponge, in the manner of veins in the higher animals, until they terminate in one or more large canals which discharge their contents through the oscula of the sponge. This system is found to obtain in the whole of the genus *Spongia* and in the massive Halichondroid sponges, which have their oscula dispersed over their external surfaces. By this mode of organization the inhaled fluid, laden with nutritive particles, is poured at pleasure into the internal cavities of the sponge, flowing over extensive membranous surfaces coated with sarcode; so that the aggregated surfaces become a great system of intestinal action, fully equal in proportional extent to that of the intestines of the most elaborately organized mammal.

They do not in every genus exhibit the regularity of structure described above, and in some cases the canalicular form resolves itself into a series of irregularly formed spaces. In other cases, where a common cloaca exists, there appears to be but one system of interstitial canals, those which convey the inhaled fluid from the pores through the substance of the sponge to the parietes of the great central cloacal cavity which receives the whole of the fæcal streams, rendering the system of excurrent canals unnecessary.

"In the Cyathiform sponges we find a somewhat similar structure. The outer portion of the cup is essentially the inhalant surface, and the interior of it the exhalant one, and there accordingly we generally find a great number of small oscula dispersed on all parts of it, very often having their margins slightly elevated, that the fæcal matter that issues may be discharged free of the surrounding membrane.

"The large fistular projections which form such striking and beautiful objects in the genus *Alcyoncellum* are also great cloacal organs, their dermal membranes abounding in pores, and their inner surfaces furnished with oscular orifices, the intervening space being occupied by the interstitial cavities, the interior forming one large cloacal cavity, which discharges its contents through a cribriform mouth at its distal end. In *Grantia* both systems, the incurrent and excurrent interstitial canals, become very nearly obsolete, but large intermarginal cavities or cells imbibing the water through their pores on the distal extremities, and becoming enlarged and elongated until they reach the parietes of the great central cloaca, into which they discharge their contents, each through a single osculum, into a short depression or cavity in the parietes of the great cloaca, and this shallow cavity represents the nearly obsolete system of excurrent canals."

The reproduction of sponges is as yet imperfectly understood, but as the ova and spermatozoa seem to have been distinctly observed in Tethea and ovarian vessels filled with ova are known in Spongilla, a regular reproduction by fertilized ova may be assumed to occur where it has not yet fallen under notice, and there is no doubt of gemmation also occurring; besides which, the colonies of animalcules which according to our idea constitute the sponge, occasionally divide, each portion separately increasing in numbers so as to form a complete new compound body. Many particulars respecting the known ovaria of sponges, and their germination internal and external are given by Dr. Bowerbank. A very important part of his work is also devoted to the explanation of his mode of classification, incomparably the best that has yet been proposed, and the discussion of the circumstances which afford the best characters for genera and species. The whole is illustrated by an admirable series of plates by Aldous, forming a most interesting specimen of what can be accomplished in the representation of microscopic objects. Of the value of the work as a contribution to natural science we feel that we cannot speak too highly. It adds to the important obligations conferred on science by the Ray Society, a happily planned association deserving extensive support, to which Canada ought to contribute more members than it has yet done.

W. H.

OBITUARY OF SCIENTIFIC MEN.

Death has been busy in the world of science since our last issue; and we must not omit to record our losses, though our readers may, most of them, have seen elsewhere fuller notices of the eminent men whom we can do little more than name with the respect due to their talents and worth.

Mr. Hugh Cuming, whose reputation is world-wide as a Natural History traveller and collector, and as a conchologist, possessing the finest series of shells ever brought together, died at his residence, Gower Street, London, on the 10th of August. He has contributed largely to the advancement of the

Natural Sciences; and none could see him without being impressed with his enthusiasm and his liberality in opening his vast stores to those interested in his pursuits.

Sir WILLIAM JACKSON HOOKER, Director of Kew Gardens, and one of the most eminent botanists of the age, as well as the possessor of one of the finest herbaria ever formed, died at Kew, on the 12th of August, having just completed his eightieth year. He was the author of upwards of fifty volumes of descriptive botany, and his labours only closed with his life. It is justly said of him, in the notice of his death in the *Athenæum:* "His address and bearing were singularly genial and urbane, and he was as remarkable for the liberality and uprightness of his disposition, as for the simplicity of his manners and the attractive style of his conversation." He has passed away at a ripe age, after devoting his whole life to the pursuit of science, deeply regretted by all who had the happiness of knowing him, universally esteemed as a public officer, and with a reputation second to none for the extent and accuracy of his botanical knowledge.

On the 2nd of September, Sir WILLIAM ROWAN HAMILTON, Astronomer Royal for Ireland, and eminently distinguished as a mathematician and astronomer, died at Dublin, at the age of 60. He was beloved for the kindness of his heart, and respected for the integrity of his character, as well as admired for the wonderful power of his intellect.

CANADIAN INSTITUTE.

SESSION—1864-65.

SECOND ORDINARY MEETING—10*th December*, 1864.

Rev. J. McCAUL, LL.D., President, in the Chair.

I. The nomination of office-bearers for the ensuing year took place.

II. *The following Papers were read:*

1. By the Rev. W. Hincks F.L S., &c.:
 "On the King Vulture and other Birds of tropical America"; illustrated by specimens recently received.
2. By the Rev. H. Scadding, D.D.:
 "On Errata Recepta written and spoken."

THE ANNUAL GENERAL MEETING—17*th December*, 1864.

I. *The following Gentlemen were elected Members:*

WILLIAM FREELAND, ESQ., Toronto.

M. B. JACKSON, ESQ, Toronto.

II. *The following Donations for the Library were announced, and the thanks of the Institute voted to the donors.*

From Geographical Society, London.

Proceedings of Vol 8, 1–6, 1863-4 .... *1
Journal of 1862. Vol. 32 .... *1
From Geological Society, London.
Quarterly Journal of February, 1864. Vol. XX., Part 1, No. 77 .... *1
May " " " 2, " 78 .... *1
August " " " 3, " 79 .... *1
The annual address by the President, 1864 .... *1
From Smithsonian Institution, Washington.
Meteorologische Waarnemeregen, &c., 1863 .... *1
From the Publisher, John Lovell, Montreal.
The Union of the Colonies by P. S. Hamilton *1

III. The report of the Council for the year 1863-64 was read and adopted.

On Motion of S. M. Jarvis, Esq, seconded by S. Spreull, Esq.,

IV. The following gentlemen were declared Office-bearers and Council, without ballot, as only the requisite number had been proposed:

President, Vice Chancellor Hon. O. Mowat.

1st Vice-President,	Prof. E. J. Chapman, Ph. D.
2nd Vice-President,	Prof. G. T. Kingston, M.A.
3rd Vice-President,	M. Barrett, Esq., M.D.
Treasurer,	S. Spreull, Esq.
Recording Secretary,	W. Mortimer Clark, Esq.
Corresponding do	U. Ogden, Esq., M.D.
Curator,	W. B. McMurrich, Esq.
Librarian,	Rev. H. Scadding, D.D.
Council,	Rev. J. McCaul, LL.D.
Do	Prof. H. Croft, D.C L.
Do	Prof. J. B. Cherriman, M.A.
Do	Hon. G. W. Allan, M.L.C.
Do	Dr. Tucker, Esq., M.D.
Do	C. B. Hall, Esq., M.D.
Do	Rev. W. Hincks, F.L.S.. and Ex-officio as Editor of Journal.

THIRD ORDINARY MEETING—21*st January*, 1865.

The President, the Hon. Vice-Chancellor Mowat, in the Chair.

I. *The following Gentlemen were elected Members.*

Rev. L. W. Beck, M.A., Peterborough.

Kenneth Mackenzie, Esq., Q.C., Toronto.

II. *The following Donations for the Library were announced, and the thanks of the Institute voted to the donors.*

From Prof. A. D. Bache, Supt. U. S. Coast Survey:
United Coast Survey, 1862 1
From Prof. D. Wilson, LL.D., Toronto:
Smithsonian Report, 1862 1

From Vienna:

Mittheilungen die Kaiserlich-Koniglichen Geographischen Gesellschaft VI., Jahrgang, 1862 .... *1

The Law of Increase and the Structure of Man; by F. P. Liharzik, Vienna, 1862 .... *1

III. *The following Paper was read.*

By the President:

The ANNUAL ADDRESS.

FOURTH ORDINARY MEETING—*28th January*, 1865.

Vice-President, Prof. E. J. CHAPMAN, Ph D., the Chair.

I. *The following Gentlemen were elected Members.*

ALEX. WILKINSON, P.L.S., Sandwich.

W. HARRINGTON COWDRY, as Junior Member, York Mills.

II. *The following Paper was read:*

By Rev. Prof. W. Hincks, F.L.S., &c.

"Remarks on the Principles of Classification in the Animal Kingdom."

Prof. Chapman read a letter from Mr. Herrick, and made some remarks on some specimens of Minerals from the North shore of Lake Superior, exhibited by him.

III. Mr. G. A. Gilbert presented a Cube of Iron Pyrites from Peru, and two Photographs.

FIFTH ORDINARY MEETING—*4th February*, 1865.

The President, Hon. Vice-Chancellor O. MOWAT, in the Chair.

I. *The undernamed Gentleman was elected a Member.*

W. J. MACDONELL, Esq., Toronto.

II. *The following donations were announced for the Library:*

From Society of Antiquaries of Scotland:

Proceedings of, Vol. 4, Part 1, 1863 1

Do " 4, " 2, " 1

Do " 5, " 1, " 1

Memoir of Alexander Henry Kileind of Libster; by John Stuart, Scretary Society of Antiquaries of Scotland *1

III. *The following Paper was read:*

By Prof. Wilson, LL.D.:

Some Observations on the Vocal utterances of Laura Bridgeman, the blind and deaf mute, in their bearing on questions in relation to the Origin of Language, made during a recent visit to Boston.

SIXTH ORDINARY MEETING—*11th February*, 1865.

Vice-President G. T. Kingston, M.A., in the Chair.

I. *The following Papers were read:*

1. By Dr. Wilson:

"On certain characteristic Types of Canadian Heads illustrated by the Conformeteur."

By Rev. H. Scadding, D.D.:

"On Anglicised German."

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST,—JUNE, 1865.

Latitude—43 *deg.* 39.4 *min. North. Longitude*—5 *h.* 17 *m.* 33 *s. West. Elevation above Lake Ontario*, 108 *feet.*

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Excess of mean above Normal.	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Resul't. Direction.	Velocity of Wind.					Rain in inches.	Snow in inches.
	6 A.M.	2 P.M.	10 P.M.	Mean.	6 A.M.	2 P.M.	10 P.M.	ME'N		6 A.M.	2 P.M.	10 P.M.	M'N	6 A.M.	2 P.M.	10 P.M.	M'N	6 A.M.	2 P.M.	10 P.M.		6 A.M.	2 P.M.	10 P.M.	Re-sul't.	ME'N		
					°	°	°	°	°												°							
1	29.691	29.690	29.627	29.6675	61.6	64.5	56.5	61.72	+ 4.77	.346	.273	.208	.276	63	44	45	49	N	E	E N E	N 84 E	6.0	6.6	2.8	4.04	4.21	...	...
2	.617	.674	.670	.6378	54.0	63.4	57.6	58.93	+ 1.67	.282	.322	.270	.231	67	55	58	57	N E b E	E	E S E	S 83 E	3.0	5.0	1.2	2.90	3.17	...	...
3	.657	.594	.558	.6003	56.2	68.8	65.2	64.23	+ 6.68	.339	.476	.445	.430	75	67	72	71	E b S	E S E	S W b W	S 10 E	3.0	1.0	1.5	0.76	1.63	...	...
4	.610	.552	—	—	70.6	82.9	—	—	—	.574	.639	—	—	76	56	—	—	Calm.	S W b S	Calm.	S 84 W	0.0	6.4	0.0	2.48	4.57	0.260	...
5	.750	.788	.776	.7738	63.0	67.7	62.3	64.28	+ 6.12	.462	.309	.359	.410	80	58	64	68	Calm.	E S E	Calm.	S 83 E	0.0	1.0	0.0	1.36	1.38	...	...
6	.801	.743	.700	.7407	61.2	68.8	65.9	65.85	+ 7.40	.386	.449	.449	.444	70	61	70	69	Calm.	E	S W	S 58 E	0.0	5.8	5.2	1.79	2.79	...	...
7	.669	.578	.662	.6310	66.3	76.7	65.2	69.95	+11.20	.562	.643	.458	.525	87	70	73	71	S W	S S W	Calm.	S 81 W	1.5	11.0	0.0	3.24	5.99	...	...
8	.731	.738	.707	.7258	59.8	72.8	63.7	66.27	+ 7.20	.335	.475	.391	.401	65	58	63	62	N W b N	S S W	S W b W	S 78 W	3.5	6.2	3.8	2.14	3.50	...	...
9	.723	.666	.575	.6470	61.6	70.2	59.0	63.25	+ 3.83	.405	.456	.380	.419	74	61	76	72	N	N E b N	Calm.	N 28 E	0.3	1.0	0.0	1.19	1.40	0.200	...
10	.516	.669	.700	.6402	59.0	66.6	60.0	58.50	— 1.32	.464	.426	.294	.386	93	64	81	78	N E b N	N N W	N W b N	N 27 W	1.5	15.5	5.6	8.52	8.58	...	...
11	.797	.720	—	—	51.1	61.6	—	—	—	.309	.346	—	—	82	63	—	—	N W b N	S b E	Calm.	S 30 E	2.0	2.0	0.0	1.48	1.88	...	...
12	.534	.455	.549	.5123	54.4	82.9	66.3	69.12	+ 8.85	.308	.606	.444	.471	73	54	68	65	Calm.	S W b W	N b W	N 67 W	0.0	7.5	7.3	2.48	4.33	...	...
13	.671	.721	.732	.7107	58.7	59.4	55.1	58.08	— 2.50	.350	.296	.277	.298	70	58	63	61	N	E b S	E b N	N 86 E	0.5	6.2	1.6	4.04	4.33	...	...
14	.775	.736	.682	.7308	58.0	64.5	60.1	61.35	+ 0.52	.304	.229	.293	.270	62	37	57	50	N E	E b N	E b N	N 74 E	3.2	14.2	12.5	10.48	10.61	...	...
15	.670	.705	.673	.6803	58.0	59.4	59.1	59.53	— 1.60	.332	.441	.452	.442	79	88	90	87	E b N	E b N	E b N	N 79 E	1.5	4.8	3.5	3.15	3.17	0.530	...
16	.637	.660	.693	.6763	62.7	74.2	65.2	68.25	+ 6.90	.530	.677	.550	.589	93	80	83	85	E b N	S E	Calm.	S 57 E	0.5	5.8	0.8	1.16	1.28	...	...
17	.750	.762	.701	.7523	64.8	81.1	69.2	71.38	+ 9.73	.582	.810	.635	.677	95	76	93	88	Calm.	S b E	Calm.	S 1 E	0.0	2.8	0.0	1.21	1.40	..	...
18	.707	.681	—	—	67.4	76.6	—	—	—	.506	.829	—	—	76	68	—	—	Calm.	Calm.	Calm.	S 71 E	0.0	0.0	0.0	0.50	0.52	...	...
19	.587	.586	.642	.6068	66.3	73.9	63.8	70.92	+ 8.78	.603	.725	.482	.597	93	73	65	77	Calm.	S S W	N N W	N 20 W	0.0	0.5	3.8	1.91	2.45	...	...
20	.663	.659	.621	.6410	61.6	76.7	62.3	67.40	+ 4.95	.441	.452	.471	.463	81	49	84	71	N W	S S W	S W b S	S 35 W	4.3	9.0	1.8	3.77	4.21	...	...
21	.602	.615	.666	.6300	61.6	72.4	59.4	65.02	+ 2.35	.428	.326	.338	.393	73	41	78	63	Calm.	W	N W b W	N 79 W	0.0	15.0	1.5	4.59	4.94	...	...
22	.663	.707	.749	.7212	58.3	63.4	57.6	61.57	— 1.38	.321	.378	.309	.330	65	55	64	60	N	S b E	N b W	N 35 E	3.5	4.0	1.4	1.13	3.47	...	...
23	.851	.847	.791	.8222	57.2	67.4	60.9	62.20	— 0.95	.303	.391	.389	.355	64	58	72	63	Calm.	S b W	E S E	S 14 E	0.0	5.0	1.0	2.12	2.5.	...	...
24	.729	.641	.586	.6133	64.8	78.9	71.7	72.05	+ 8.70	.450	.616	.531	.552	73	65	68	70	Calm.	S S W	S W b W	S 17 W	0.0	9.0	0.5	3.78	4.39	...	...
25	.551	.453	—	—	70.2	83.2	—	—	—	.608	.651	—	—	83	57	—	—	Calm.	S E b S	S W b S	S 7 W	0.0	7.5	5.9	4.56	4.90	0.550	...
26	.272	.216	.250	.2678	63.2	74.6	61.9	66.47	+ 2.58	.590	.593	.435	.529	95	68	84	81	S W b S	S S W	W b S	S 38 W	2.8	10.4	6.0	8.23	8.73	0.180	...
27	.371	.486	.570	.4310	54.0	53.4	52.2	53.33	— 8.68	.313	.293	.295	.303	75	58	73	70	S W b W	W	N W	S 73 W	8.2	13.0	11.5	7.84	8.75	...	...
28	.642	.630	.570	.6182	53.6	64.5	55.8	53.82	— 5.67	.318	.329	.38[illegible]	.350	78	54	87	73	Calm.	E	S b E	S 23 E	0.0	1.6	3.2	2.03	3.77	0.215	...
29	.485	.333	.317	.3772	58.0	73.1	64.1	66.45	+ 2.00	.410	.542	.538	.514	86	65	90	79	E b N	S W b S	S W b S	S 54 W	3.8	15.8	8.0	3.96	5.72	0.070	...
30	.430	.516	.551	.5078	64.8	76.0	64.5	69.38	+ 4.80	.569	.504	.442	.516	92	56	73	72	S W b W	W b N	W	N 85 W	1.0	9.0	0.8	1.15	3.05	...	...
...	......	......	......	......	...	...	...	...	......	...	...	...	...	...	...	...	...	......	......	......	......	...	...	...	...	...	...	...
M	29.6357	29.6330	29.6304	29.6327	60.18	70.43	61.52	64.47	+ 3.44	.415	.468	.409	.432	78	61	73	70	....	....	....	....	1.67	6.75	3.07	....	4.06	2.005	...

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR JUNE, 1865.

NOTE.—The monthly means do not include Sunday observations. The daily means, excepting those that relate to the wind, are derived from six observations daily, namely, at 6 A.M., 8 A.M., 2 P.M., 4 P.M., 10 P.M., and midnight. The means and resultants for the wind are from hourly observations.

Highest Barometer . . . . 29.877 at 8 a.m. on 23rd. } Monthly range=
Lowest Barometer . . . . 29.232 at 4 p.m. on 26th. } 0.645 inches.

Self-registering Ther.:
- Maximum temperature . . . 90°.2 on 4th. } Monthly range=
- Minimum temperature . . . 43°.0 on 11th. } 47°2
- Mean maximum temperature . . 74°19 } Mean daily range=17°46
- Mean minimum temperature . . 56°73 }
- Greatest daily range . . . . . . 36°9 from a.m. to p.m. of 12th.
- Least daily range . . . . 6°2 from a.m. to p.m. of 13th.

Warmest day . . . . 24th ...Mean Temperature . . . 72°05 } Difference=16°.67
Coldest day . . . . . 27th ..Mean Temperature . . . 55°38 }

Maximum { Solar . . . . 128°5 on 19th } Monthly range=
Radiation { Terrestrial . . . . 33°4 on 11th } 95°.1

Aurora observed on 6 nights, viz.:—on 10th, 15th, 16th, 20th, 21st and 23rd.
Possible to see Aurora on 18 nights; impossible on 12 nights.
Raining on 7 days; depth 2.005 inches; duration of fall, 34.7 hours.
Mean of cloudiness=0.62; Most cloudy hour observed, 8 a.m; mean=0.70; least cloudy hour observed, 10 p.m; mean=0.53.

Sums of the components of the Atmospheric Current, expressed in Miles.

North.	South.	East.	West.
671.56	1043.54	882 24	1090.10

Resultant direction, S. 30° W.; Resultant Velocity, 0.60 miles per hour.
Mean velocity 4.06 miles per hour.
Maximum velocity 19.8 miles, from 8 to 9 a.m. on 27th.
Most windy day 14th—Mean velocity 10.64 miles per hour. } Difference 10.12.
Least windy day 18th—Mean velocity 0.52 miles per hour. }
Most windy hour, 1 p.m.—Mean velocity, 7.26 miles per hour. } Difference
Least windy hour, 5 a.m.—Mean velocity, 1.61 miles per hour. } 5.65 miles.

4th, Thunder storm during evening.
7th. Hot sultry day: thunder at 7 p.m. 8th. Lunar halo.
10th. Very fine auroral display 13th. Solar halo 7 a m.
16th. Distant thunder in N and W. 17th. Ground fog at night.
18th. Distant thunder in S. W.
19th Fireflies numerous. Dense fog during morning.
Dew recorded on five mornings during month.

The month of June was warm, dry, and calm. The mean temperature is the highest except 3 years, viz:—1841, 1853 and 1858.

COMPARATIVE TABLE FOR JUNE.

YEAR.	TEMPERATURE.					RAIN.		SNOW.		WIND.		
	Mean	Excess above Average	Maximum observed.	Minimum observed.	Range.	No. of days.	Inches.	No. of days.	Inches.	Resultant. Direction.	Resultant. Velocity.	Mean Force or Velocity
1840	59.8	— 1.5	78.5	37.1	41.4	11	4.860	...	...	...	...	...
1841	65.6	+ 4.3	92.8	45.7	47.1	9	1.560	...	...	...	...	0.36 lbs
1842	5 .6	— 5.7	73.9	28.0	45.9	15	5.755	...	...	...	...	0.31 "
1843	58.4	— 2.0	81.3	28.5	52.8	12	4.595	...	...	...	...	0.27 "
1844	59 9	— 1.4	82.8	33 1	49.7	9	3.535	...	...	...	...	0 19 "
1845	61.0	— 0.3	83.6	40.9	42.7	11	3.715	...	...	...	...	0.27 "
1846	63.3	+ 2 0	85.3	41.5	41.8	10	1.920	...	...	...	...	0.32 "
1847	58.4	— 2.9	78.3	36.7	41.6	14	2 625	...	...	...	...	0.30 "
1848	62 9	+ 1.6	92.5	38.3	54.2	8	1.810	...	...	N 61 W	1.9[illegible]	4 51 ms
1849	63.2	+ 1.9	84.9	45.2	39.7	7	2.020	...	...	S 71 E	0 4[illegible]	3 32 "
1850	64.3	+ 3.0	83.2	49.0	34.2	10	3.345	...	...	S 60 W	0.3[illegible]	4.54 "
1851	59.2	— 2.1	79.2	41.2	38.0	11	2.695	...	...	S 2 W	1.26	4.42 "
1852	60.8	— 0.5	86.1	43.6	42.5	10	3.160	...	...	S 76 W	1.49	4.09 "
1853	65.5	+ 4.2	86.3	43.3	43.0	9	1.550	...	...	N 1 W	0.1[illegible]	3.73 "
1854	64.1	+ 2.8	88.7	47.4	41.3	9	1.460	...	...	N 24 E	0.71	4 15 "
1855	59.9	— 1.4	90.7	40.6	50.1	17	4.070	...	...	N 69 W	1.3[illegible]	5.70 "
1856	62.1	+ 0.8	82.6	48.3	34.3	13	3 200	...	...	S 21 W	0.90	5 30 "
1857	56.9	— 4.4	75.1	40.9	34.2	21	5.060	...	...	N 49 W	1.1[illegible]	7.60 "
1858	66.2	+ 4 9	86.3	48.7	37 6	12	2.943	...	...	S 20 E	0.2[illegible]	5.53 "
1859	58 3	— 3.0	85.2	33.9	51.3	16	4.085	2	Inp.	N 77 W	1.9[illegible]	7.19 "
1860	63.2	+ 1.9	81.1	50.0	31.1	14	2.136	...	...	N 44 W	3.1[illegible]	7.61 "
1861	61.3	0.0	86.5	48.2	38.3	13	2.329	...	...	N 39 W	2 [illegible]	6.11 "
1862	60.5	— 0.8	83.2	44.3	38.9	10	1.007	...	...	N 26 W	1.7[illegible]	5.98 "
1863	60.1	— 1.2	79.3	45.0	34.3	13	1.682	...	...	N 50 W	2.2	5.24 "
1864	63.0	+ 1.7	92.6	41.7	50.9	5	0.570	...	...	N 55 W	1.72	4.53 "
1865	64.5	+ 3.2	90.2	43.0	47.2	7	2.005	...	...	S 30 W	0.60	4.06 "
Results to 1864.	61.34	...	83.92	41.64	42.28	11.6	2.867	...	...	N 61 E	0.98	5 27
Exc. for 1865.	+3.16	...	+6.28	+1.36	+4.92	— 4.6	— 0.862	...	...	...	...	+1 21

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST,—JULY, 1865.

Latitude—43 deg. 39.4 min. North. Longitude—5 h. 17 min. 33 sec. West. Elevation above Lake Ontario, 108 feet.

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Excess of mean above Normal.	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Resultant Direction.	Velocity of Wind.					Rain in Inches.	Snow in Inches.
	6 A.M.	2 P.M.	10 P.M.	MEAN.	6 A.M.	2 P.M.	10 P.M.	ME'N		6 A.M.	2 P.M.	10 P.M.	M'N	6 A.M.	2 P.M.	10 P.M.	M'N	6 A.M.	2 P.M.	10 P.M.		6 A.M.	2 P.M.	10 P.M.	Re-sult't.	ME'N		
1	29.555	29.494	29.417	29.4898	63.4°	68.4°	64.8°	65.30°	+ 0.53°	.521	.58	.528	.537	89	84	87	86	Calm.	E b S	W b N	S 77° E	0.0	11.0	3.0	1.70	3.47	Inp	...
2	.421	.485	—	—	61.6	67.0	—	—	—	.468	.418	—	—	86	67	—	—	Calm.	W b S	W	S 88 W	0.0	19.0	0.9	7.62	7.80	0.025	...
3	.612	.594	.572	.5615	60.5	72.4	63.4	65.45	+ 1.30	.419	.468	.393	.413	80	58	67	64	W	S S W	S W b W	S 40 W	0.8	10.0	0.5	4.28	4.50	...	...
4	.619	.608	.637	.6323	65.9	77.1	67.4	69.70	+ 4.49	.500	.418	.378	.410	78	44	56	57	W	S	N [illegible] W	[illegible] 50 W	3.0	6.0	6.0	4.36	6.23	...	...
5	.768	.766	.776	.7722	62.3	70.2	60.0	64.82	— 0.57	.348	.354	.331	.338	62	48	62	56	N	S S W	S S W	S 61 W	3.5	4.8	2.2	0.83	2.65	Inp	...
6	.793	.639	.491	.6320	59.0	69.2	64.5	64.88	— 1.72	.439	.392	.467	.446	88	55	76	74	N W	E	Calm.	N 74 E	3.0	8.5	0.0	1.80	3.92	0.056	...
7	.523	.556	.643	.5790	73.8	79.6	61.6	71.85	+ 6.15	.665	.454	.368	.477	72	45	67	61	W	W	N W b N	N 60 W	6.5	15.2	6.5	9.86	10.20	..	...
8	.658	.600	.575	.6050	63.0	76.0	64.5	67.35	+ 1.57	.462	.475	.430	.439	80	52	71	66	Calm.	S b W	W S W	S 33 W	0.0	8.0	1.0	3.50	3.89	...	...
9	.674	.723	—	—	61.6	71.0	—	—	—	.420	.394	—	—	76	52	—	—	N W b N	S b W	N N W	N 12 W	1.4	6.2	5.9	4.30	5.99	..	...
10	.771	.698	.576	.6737	59.1	68.1	61.9	64.65	— 1.43	.345	.270	.280	.309	68	39	52	51	N	E S E	Calm.	N 82 E	2.2	2.0	0.0	2.05	2.52	...	...
11	.642	.515	.507	.5167	60.1	73.8	64.1	68.87	+ 0.68	.366	.369	.409	.382	70	44	68	59	N E b N	S b W	Calm.	S 10 W	2.0	9.0	0.0	1.43	2.56	...	...
12	.503	.440	.518	.4832	60.5	72.8	52.6	62.73	— 3.57	.360	.436	.310	.3[illegible]6	69	54	78	67	Calm.	S S W	W N W	N 87 W	0.0	3.0	15.0	6.58	7.46	1.190	...
13	.573	.681	.707	.6532	54.1	63.4	51.8	56.23	—10.15	.208	.254	.300	.283	69	43	78	64	W b N	N W b N	W b N	N 57 W	14.5	18.0	2.2	11.29	11.83	...	...
14	.735	.693	.607	.7075	50.9	66.6	52.9	56.82	— 9.60	.283	.268	.274	.276	76	40	69	62	N W b W	W b N	Calm.	N 75 W	9.0	10.8	0.0	4.95	4.99	...	...
15	.690	.677	.659	.6820	49.0	61.6	52.6	53.75	—10.73	.297	.306	.279	.297	85	54	71	67	Calm.	S S E	Calm.	S 44 E	0.0	4.6	0.0	1.29	1.89	..	...
16	.608	.545	—	—	53.3	60.5	—	—	—	.312	.326	—	—	76	62	—	—	Calm.	E S E	Calm.	N 53 E	0.0	2.0	0.0	1.58	2.70	0.015	...
17	.530	.614	.521	.5192	58.7	72.0	58.3	63.80	— 2.83	.373	.231	.301	.296	75	28	60	52	N b W	N W b N	Calm.	N 41 W	5.2	13.0	0.0	6.13	6.37	...	...
18	.478	.393	.420	.432[illegible]	63.1	80.0	61.2	66.98	+ 0.30	.366	.327	.220	.314	70	31	40	47	W b N	W b S	S W	S 69 W	1.5	14.8	3.3	8.77	9.17	..	...
19	.403	.369	.336	.3472	59.8	62.7	59.0	60.73	— 6.05	.428	.433	.462	.447	83	75	93	84	S W	S b W	Calm.	S [illegible] W	1.0	1.5	0.0	1.76	2.08	0.120	...
20	.480	.493	.569	.5227	58.0	74.0	58.3	66.10	— 0.67	.441	.518	.445	.464	92	59	68	73	E b N	S S W	N W	S 38 W	2.0	13.2	3.5	4.72	6.47	0.090	...
21	.601	.738	.689	.7072	61.9	65.6	65.5	65.72	— 1.05	.380	.403	.451	.437	70	62	72	69	N W b N	S S W	N N E	N 21 E	0.8	0.5	6.0	2.52	4.05	...	...
22	.772	.811	.775	.7815	61.9	68.4	64.1	64.75	— 2.12	.342	.39[illegible]	.301	.333	62	56	50	58	N E b N	S	N N W	N 46 E	6.0	7.4	5.5	0.87	4.07	...	...
23	.785	.707	—	—	59.1	74.5	—	—	—	.345	.399	—	—	69	48	—	—	N N W	S	Calm.	S 72 W	2.0	2.5	0.0	0.72	2.28	...	...
24	.723	.700	.638	.6792	59.4	71.3	64.5	65.73	— 1.13	.373	.411	.467	.428	71	55	76	68	Calm.	S S W	S S W	South.	0.0	2.5	2.0	1.54	2.33	Inp	...
25	.491	.306	.312	.3575	63.4	70.6	65.6	66.93	— 0.03	.457	.640	.493	.518	78	86	77	78	E b N	S S W	S W b W	S 48 W	7.0	11.0	6.5	8.16	10.68	0.010	...
26	.383	.451	.545	.4648	65.2	78.0	67.0	70.78	+ 3.82	.430	.478	.498	.482	73	48	76	65	W b S	W b N	W N W	N 73 W	14.5	26.5	0.5	12.11	12.53	...	...
27	.560	.536	.490	.5272	63.0	80.3	63.2	70.45	+ 3.47	.462	.518	.420	.481	80	50	72	65	W N W	S W b S	Calm.	S 3[illegible] W	1.2	4.0	0.0	1.33	1.42	...	...
28	.469	.488	.506	.4948	69.9	77.1	66.3	71.50	+ 4.63	.626	.590	.419	.551	86	65	64	71	Calm.	S b W	N b W	S 52 W	0.0	5.2	3.8	1.10	3.35	0.070	...
29	.605	.616	.757	.6757	57.6	71.7	57.3	63.28	— 3.67	.446	.42	.302	.372	94	55	64	66	Calm.	S b E	N W b N	N 40 W	0.0	4.8	11.0	4.95	7.23	...	...
30	.846	.895	—	—	52.0	65.2	—	—	—	.296	.351	—	—	74	57	—	—	N b E	S b W	S S W	S 6 W	3.8	6.0	2.6	1.87	3.82	...	...
31	.935	.942	.910	.9345	54.0	66.6	57.3	60.38	— 6.57	.324	.278	.368	.324	78	43	78	63	W N W	E S E	E b S	S 79 E	1.0	8.8	4.0	5.72	5.99	...	...
M	29.6125	29.5877	29.5866	29.5948	60.57	71.51	61.48	65.02	— 1.23	.413	.4.2	.331	.402	77	53	69	65	....	....	....	....	2.03	8.38	2.00	.....	5.34	2.470	.....

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR JULY, 1865.

NOTE.—The monthly means do not include Sunday observations. The daily means, excepting those that relate to the wind, are derived from six observations daily, namely at 6 A.M., 8 A.M., 2 P.M., 4 P.M., 10 P.M., and midnight. The means and resultants for the wind are from hourly observations.

Highest Barometer.........................29.976 at 8 a.m. on 31st } Monthly range =
Lowest Barometer ....29.247 at 4 p.m. on 25th } 0.729 inches.

Self-register'ing Thermom.
- Maximum Temperature ....83°0 on 28th } Monthly range =
- Minimum Temperature ....45°8 on 15th } 37°2
- Mean maximum Temperature ....74°14 } Mean daily range =
- Mean minimum Temperature ....55°63 } 18°51
- Greatest daily range......20°0 from a.m. to p.m. of 18th.
- Least daily range ....11°6 from a.m. to p.m. of 22nd.

Warmest day......... 7th ..Mean temperature...............71°85 } Difference = 26°10
Coldest day......... 15th ..Mean temperature...............55°75 }

Maximum } Solar.....................................126°5 on 7th } Monthly range =
Radiation. } Terrestrial ....36°0 on 15th } 90°5

Aurora observed on 7 nights, viz:—7th. 13th, 14th, 17th, 18th. 19th, and 22nd.
Possible to see Aurora on 24 nights; Impossible on 7 nights.
Raining on 11 days, depth 2.470 inches; duration of fall 17.5 hours.
Mean of cloudiness = 0.53.
Most cloudy hour observed, 2 p.m.; mean = 0.69; least cloudy hour observed, 10 p.m.; mean, = 0.46.

Sums of the components of the Atmospheric Current, expressed in miles

North.	South.	East.	West.
1213.98	1099.77	509.37	2199.28

Resultant direction N. 86° W.; Resultant velocity 2.28 miles per hour.
Mean velocity ....5.34 miles per hour.
Maximum velocity.... ....28.8 miles, from 9 to 10 a.m.
Most windy day ....26th..............Mean velocity, 12.53 miles per hour. } Difference =
Least windy day ....15th ....Mean velocity, 1.89 ditto } 10.64 miles
Most windy hour ...... 1 p.m.........Mean velocity, 9.18 ditto } Difference =
Least windy hour......12 p.m.........Mean velocity, 2.88 ditto } 6.30 miles.

1st. Very dense fog. 7th. Lunar halo, 10 p.m.
19th. Solar halo; dense ground fog at night.
20th. Dense fog a.m.
25th. Very heavy rain storm; brilliant rainbow, 7 p.m. 29th. Morning foggy.
Dew recorded on nine occasions during month.

The month of July, 1861, was cool and dry, while the mean velocity and mean cloudiness closely approximated to the average.

COMPARATIVE TABLE FOR JULY.

YEAR.	TEMPERATURE.					RAIN.		SNOW.		WIND.		
	Mean.	Excess above averge	Max. ob-served.	Min. ob-served.	Range	No. of days.	Inches	No. of days.	Inches	Resultant. Direction.	Resultant. V'y	Mean Force or Velocity.
1840	65.8	− 1.[illegible]	79.4	48.2	31.2	6	5.27[illegible]	...	...	...	...	....
1841	65.0	− 2.[illegible]	86.3	43.2	43.[illegible]	10	8.15	...	...	...	...	0.27 lbs.
1842	64.7	− 2.[illegible]	90.5	42.0	48.5	4	3.05[illegible]	...	...	...	...	0.33
1843	64.5	− 2.[illegible]	86.1	40.2	45.[illegible]	8	4.00	...	...	...	...	0.44
1844	66.0	− 1.[illegible]	86.1	40.5	45.[illegible]	12	2.81	...	...	...	...	0.19
1845	66.2	− 0.8	94.6	45.6	49.[illegible]	7	2.[illegible]9	...	...	...	...	0.30
1846	68.0	+ 1.[illegible]	94.0	44.9	49.1	9	2.89	...	...	...	...	0.29
1847	68.0	+ 1.[illegible]	87.5	43.8	43.7	8	3.35[illegible]	..	...	...	...	0.19
1848	65.5	− 1.[illegible]	82.7	46.7	36.0	10	1.89[illegible]	..	...	N 14° W	0.18	4.94mls.
1849	68.4	+ 1.4	89.1	51.0	38.1	4	3.41[illegible]	...	...	S 5° W	0.75	3.52
1850	68.9	+ 1.[illegible]	84.9	52.8	32.1	12	5.27[illegible]	...	...	N 81° E	0.59	4.56
1851	65.0	− 2.[illegible]	8[illegible].7	52.1	30.6	12	3.62[illegible]	...	...	N 60° W	0.88	4.13
1852	66.8	− 0.2	90.1	49.5	40.[illegible]	8	4.02[illegible]	...	...	N 43° W	0.94	3.33
1853	65.6	− 1.4	85.4	49.4	36.[illegible]	10	0.91[illegible]	..	...	S 58° E	0.24	3.69
1854	72.5	+ 5.[illegible]	93.6	53.0	40.[illegible]	9	4.80[illegible]	..	...	S 49° W	0.37	4.03
1855	67.9	+ 0.[illegible]	88.4	53.1	35.[illegible]	13	3.24[illegible]	...	...	S 19° W	0.73	6.47
1856	69.9	+ 2.9	92.0	51.4	40.6	8	1.12[illegible]	...	...	N 79° W	1.67	5.84
1857	67.8	+ 0.8	85.4	52.4	33.[illegible]	15	3.47[illegible]	...	...	S 88° E	0.81	4.74
1858	67.9	+ 0.[illegible]	83.4	55.9	27.5	13	3.07[illegible]	...	...	N 15° E	1.13	5.76
1859	66.9	− 0.[illegible]	87.7	50.5	37.2	12	2.61[illegible]	...	...	N 56° W	1.18	5.81
1860	63.9	− 3.	85.8	47.5	38.[illegible]	13	4.33	...	...	N 60° W	2.15	7.20
1861	65.4	− 1.[illegible]	82.9	49.4	33.5	16	2.63[illegible]	...	...	N 74° W	1.43	4.66
1862	66.7	− 0.[illegible]	88.6	52.6	36.0	15	5.34[illegible]	...	...	S 89° W	1.42	5.80
1863	67.6	+ 0.[illegible]	82.3	49.3	33.0	15	3.40	...	...	N 18° W	0.40	3.89
1864	69.7	+ 2.7	87.9	52.9	35.0	8	1.33[illegible]	...	...	N 61° W	2.23	6.00
1865	65.0	− 2.0	83.0	45.8	37.2	11	2.47[illegible]	...	...	N 86° W	2.28	5.34
Results to 1864.	66.98	...	87.10	48.72	38.38	10.3	3.474	...	...	N 66° W	0.63	4.97
Excess for 1865.	− 1.98	...	− 4.10	−2.92	− 1.18	+ 0.7	− 1.004	...	...	....	..	+ 0.37