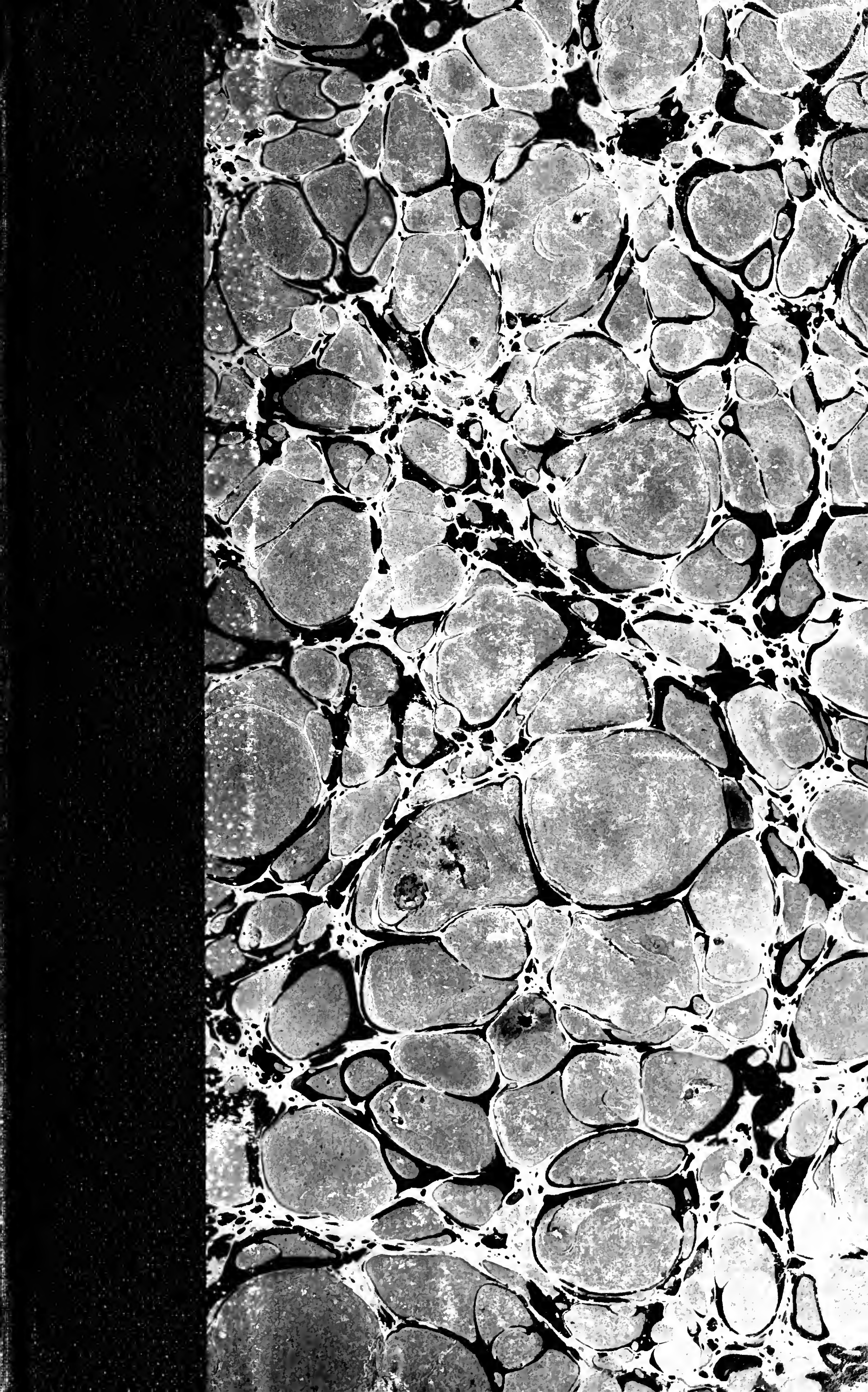

JOURNAL

OF THE

ELISHA MITCHELL

SCIENTIFIC SOCIETY,

FOR THE YEAR 1883-'84.

PUBLICATION COMMITTEE:

R. H. GRAVES,

W. B. PHILLIPS,

T. W. HARRIS.

RALEIGH:
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1884.

OFFICERS.

1883—1884.

PRESIDENT—F. P. VENABLE, Ph. D., F. C. S.

VICE-PRESIDENT—J. A. HOLMES, B. Agr.

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R. H. GRAVES, B. Sc., C. & M. E.
W. B. PHILLIPS, Ph. D.
T. W. HARRIS, A. M., M. D.

JOURNAL OF THE

ELISHA MITCHELL SCIENTIFIC SOCIETY.

PRESIDENT'S REPORT FOR 1884.

F. P. VENABLE.

The Mitchell Society has completed the first year of its existence and it becomes the duty of the President to submit a report as to the work accomplished and proposed, and the general well-being of the Society.

The formation of a Scientific Society was first proposed at a meeting of several gentlemen, connected with the scientific department of the University, held on September 24th, 1883. A call was then issued to all who were thought to be interested in the development of the State or the progress of science, in order to see whether the encouragement would be sufficient to justify a permanent organization. The proposed aims of the Society were the arousing of an increased interest in scientific work, the building up of a spirit of research, the encouraging of those already at work and the advancing of our knowledge of the State and its resources. The plan or system of work for the Society was to have the centre of the organization at the University with enough resident members there for the transaction of business. Monthly meetings were to be held, at which popular treatises on scientific subjects were to be read with the hope of interesting and training up a number of young scientific workers. An annual Journal was to be published containing all papers on original work or observations, contributed by members of the Society.

At a second meeting held October 1st, 1883, a regular constitution was adopted and the first monthly meeting arranged for the second Saturday in November. Many encouraging replies were received from those to whom the call had been sent and the Society now has upon its roll of members the names of 7 life members, 75 regular members, and 74 associate members, or 156 in all, a most gratifying showing for the first year. With so cordial a support, the Society

The following officers were elected for the year beginning October, 1884:

Dr. W. C. Kerr, President; Col. W. J. Martin, Vice-President; Prof. J. W. Gore, Resident Vice-President; Prof. F. P. Venable, Secretary and Treasurer; Profs. R. H. Graves and J. A. Holmes and Dr. W. B. Phillips, Executive Committee.

On recommendation of Council, the following were elected honorary members:

Prof. Joseph LeConte, Berkely, Cal.; Dr. James C. Southall, Richmond, Va.; Prof. Charles U. Shepard, Charleston, S. C.

Adjourned. J. W. Gore.

PAPERS PRESENTED BEFORE THE SOCIETY.

November 10, 1883.

1. President's Address.................F. P. Venable.
2. Biography of Dr. Mitchell.................Chas. Phillips.
3. Insectivorous Plants.................J. A. Holmes.
4. Action of Sulphate of Calcium on Potassium Cyanide (read by title).................J. F. Wilkes.

December 8, 1883.

5. Southward Growth of Florida.................J. A. Holmes.
6. Ptolemaic Astronomy.................R. H. Graves.
7. Artificial Milk and Butter.................F. P. Venable.
8. Primitive Rocks.................A. E. DeSchweinitz.
9. Estimation of Phosphoric Acid and Value of Fine Ground Phosphates (read by title).................Dr. W. B. Phillips.

January 12, 1884.

10. "Radiant Matter" (illustrated by experiments).................J. W. Gore.
11. South Carolina Phosphates.................H. B. Battle.
12. Singular Sunsets and Sunrises (Fall of 1883).................F. B. Venable.
13. Elements and Supposed Elements (read by title).................J. C. Roberts.
14. Chemical Examination of Drinking Waters (read by title).................A. E. DeSchweinitz.
15. Rain Storm of April 22d, 1883, (read by title).................F. P. Venable.

February 9, 1884.

16. N. C. Phosphate Rocks and Tinstone.................Chas. W. Dabney.
17. The Pons-Brooks Comet.................R. H. Graves.
18. Applications of Electricity.................J. W. Gore.
19. Volcanic Eruptions in Straits of Sunda.................J. A. Holmes.

20. Action of Gravity on one Atom .... Chas. Phillips.

Read by title:

21. Action of Ammonia on Lead Chloride .... Julian Wood.
22. Decomposition of Red Hematite (Chapel Hill Mine) .... F. P. Venable.
23. Barometrical Determination of Elevation of Chapel Hill .... J. W. Gore.
24. Stability of Filters washed by Hydrofluoric Acid .... F. P. Venable.
25. Observation on movement of Water .... J. A. Holmes.
26. Note on Lunar Halos .... F. P. Venable.

March 8th, 1884.

27. Rosin and Turpentine .... W. B. Phillips.
28. Dissolved Phosphates .... H. B. Battle.
29. Tornado of February 19th, 1884 .... J. A. Holmes.

Read by title:

30. Results of Observation on Pressure and Temperature at Chapel Hill .... Chas. Phillips.
31. Estimation of Phosphoric Acid as Magnesium Pyro-Phosphate .... J. L. Borden
32. Alterability of Amorphous Phosphorus .... J. C. Roberts.
33. Solvent Action of Gasoline on Copper .... F. P. Venable.
34. Caffeine in Yeopon Leaf .... F. P. Venable.

April 12th, 1884.

35. Rotation of the Eearth .... R. H. Graves.
36. The "Chatham Blood Shower" .... F. P. Venable.
37. Tornado of March 25th, 1884 .... J. A. D. Stephenson.
38. Principle and Applications of the Spectroscope (Illustrations by Lantern) .... F. P. Venable.

Read by title:

39. Oxyiodides of Lead .... J. L. Borden.
40. Time of Flowering of Plants (at Chapel Hill) .... Chas. Phillips.
41. Zinc in Drinking Water .... F. P. Venable.
42. Indian Mounds in Eastern North Carolina .... J. A. Holmes.
43. Magnetite from Orange county, N. C. .... L. J. Borden.
44. Measurement of Amethyst Crystals .... R. H. Lewis.
45. Note on Reverted Phosphate .... W. B. Phillips.

May 2d, 1884.

46. Theory of Tornadoes .... J. W. Gore.
47. Coal-tar Products .... F. P. Venable.
48. History of the Observatory of the Univ. of N. C. .... Chas. Phillips.

Read by title:

49. Silk Industry .... Julian Wood.
50. Medical Practice among Indians .... Geo. Mallett.
51. Sources of Phosphoric Acid .... J. C. Roberts.

52. Production of Butter and Milk .... J. P. KERR.
53. Double Acetate of Copper and Barium .... J. C. ROBERTS.
54. Relative Solubility of North Carolina and South Carolina Phosphates .... J. L. BORDEN.
55. Analysis of Cotton Seeds .... A. E. DESCHWEINITZ.
56. Nature of precipitate from Phosphorus in Carbon Bi-Sulphide and Sulphate of Copper .... F. P. VENABLE.
57. Hydrate of Carbon Bi-Sulphide .... F. P. VENABLE.
58. Analysis of Rock Salt from Virginia .... THOS. RADCLIFFE.
59. Zinc deposit in blast furnace .... THOS. RADCLIFFE.
60. Reversion of Phosphoric Acid in Superphosphate from Red Nevassa Rock .... W. B. PHILLIPS.
61. Occurrence of N. C. Phosphate in Duplin and Onslow counties .... W. B. PHILLIPS.
62. Geographical Distribution of Certain Plants in N. C. .... J. A. HOLMES.
63. Note on Indian Arrow Heads in Eastern N. C. .... J. A. HOLMES.
64. Temperature of Well Waters at Chapel Hill .... F. P. VENABLE.
65. Note on Distribution of Earth Worms .... R. L. UZZELL and E. F. STRICKLAND.
66. Note on Food of Cat Fish .... W. A. GRAHAM.
67. Note on Amount of Sand in Alimentary Canal of Birds .... M. R. BRASWELL.

TREASURER'S REPORT.

	DR.	CR.
Annual Fees	$164 50	
Contributions for expenses	7 00	
Stationery and stamps		$23 08
Expenses of monthly meetings		14 00
	$171 50	$37 08
Amount in Treasury May 1st, 1884	$134 42	

J. W. GORE.

A SKETCH OF ELISHA MITCHELL.

He whose name this Society bears, the Rev. ELISHA MITCHELL, D. D., late Professor of Chemistry, Mineralogy, and Geology in this University, was born in Washington, Litchfield county, Conn., on he 19th day of August, 1793. He was a Naturalist by inheritance, by inclination, by education, and by profession. His father was a very respectable farmer. His mother, a descendant of John Eliot, "the Apostle to the Indians," was the grand-daughter of the Rev. Jared Eliot, M. D. and D. D., a man distinguished in his day for a successful pursuit of knowledge in many branches of Natural Science. He was a correspondent of learned men, such as Dr. Franklin and Bishop Berkely, and in 1762 received, from the Royal Society of London, a gold medal for improving the manufacture of iron. From this ancestor Dr. Mitchell inherited, besides delight in the phenomena of Nature, and curiosity for its secrets, personal qualifications that fitted him well for the life he chose. Like him he was of a commanding presence, great bodily vigor, quaint humor, solid and sensible piety, and liberal philanthropy. Insatiable desire for knowledge was the prominent characteristic of Dr. Mitchell from his boyhood. It was then his delight to spend his play-time in telling his school-mates what he had seen in his rambles, heard from his elders, or read in his books and newspapers. This tendency towards objective Science was wisely and skillfully strengthened by his preceptor in classical studies, the Rev. Dr. Backus, who, as a school-master, and as the President of Hamilton College, N. Y., was, in the early part of this century, famous for his excellent common sense, his keen wit, his large acquaintance with Science and Literature, and his devout deference to the teachings of Inspiration. Thus it was that the bending of the twig in Connecticut determined the inclination of the tree in North Carolina.

Fortunate in his parentage, and in his pupilage, Dr. Mitchell was equally fortunate in his associations while a student at Yale College. There he became a marked man by the depth and breadth of his culture. Standing always at the head of his class, he was repeatedly selected by his fellow-students to represent them on public occasions. The dignity of his bearing, his handsome face, the originality of the views he set forth, the humor with which he enlivened his arguments, and the evident intimacy of his acquaintance with great English authors, made his orations and debates both instructive and delightful to all men of taste and learning. To say that he was a marked man in the class of 1813, a class that contained Dr. Olmsted of Yale College, President Longstreet of Georgia, and Mr. Thomas P. Devereux, the Rev. Mr. Singeltary and Judge Badger of North Carolina, is to say that his honors bore the signs of a vigorous and well contested race. The last year of his course at Yale College was ever memorable to him, because in it he joined the Church of his fathers. The determination to do so was formed by the earnest and gentle persuasion of a class-mate, a man by no means his equal in the grasp or activity of his mental powers. So it was all through his life. He who was often hard to move by argument, and generally firmly fixed in the face of opposition, yielded a ready acquiescence to truth addressed to his heart. He often gave what no man could take from him.

Dr. Mitchell began his life-long work of teaching, immediately after graduating, by becoming an usher in the school of the Rev. Dr. Eigenbrodt, a notable pedagogue of Jamaica, L. I. In the spring of 1815, he took charge of a seminary for girls in New London, Conn. There again, while busy with the head, he became interested in the affairs of the heart. His love for Nature found satisfaction in visiting the library and enjoying the conversation of Dr. North, who had a great name as a Physician and as a Physicist. In Dr. North's family he also found, in the person of his daughter, the wife who, from 1819 until he died, made his home delightful to him by the wisdom, dignity, intelligence and charity with which she presided over their household. A nephew of Mrs. Mitchell, Dr. H. Carrington Bolton, is now sustaining his grand-father's reputation as the Professor of Chemistry in Trinity College, Hartford, Conn., and so adds another to the group of scientific men with whom Dr. Mitchell must be associated.

In 1816 Dr. Mitchell became a tutor in Yale College. While thus beginning to increase the fame and power of his Alma Mater he attracted the attention of the Rev. Sereno Dwight, at that time Chaplain of the Senate of the U. S. Mr. Dwight mentioned him, with Dr. Olmsted, to Judge Gaston, then a member of the House of Representatives, as two young men likely to become prominent Scientists. The Trustees of this University were, at that time, looking for men fit to fill the chairs of Mathematics and of Chemistry which they had lately established here. On the recommendation of Judge Gaston, Dr. Olmsted was chosen Professor of Chemistry, Mineralogy and Geology—while to Dr. Mitchell was assigned the Professorship of Mathematics and Natural Philosophy. Dr. Mitchell did not repair to Chapel Hill at once; but spent a year in studying Theology in the Seminary at Andover, Mass. This he did that he might be the better prepared to learn and to teach whatever Science might discover or Revelation inculcate. So it happened that it was January, 1818, when Dr. Mitchell began his labors in the professor's chair and the preacher's pulpit—labors not interrupted till his death in 1857, but continued during nearly forty years with great energy, rare intelligence, and notable success—forty years of wonderful discoveries in Science and profound discussions in Religion.

As has been already stated, Dr. Mitchell came to our University to be its Professor of Mathematics and Natural Philosophy. The ardor with which he entered on this professorship is evident in the pages of a manuscript volume which lies before us, entitled "*Compte ouvert de mes etudes, mes pensees—de mon etre.*" Its first entry is dated "*Sept.* 9, 1818," and mentions his "*mathematical studies unconnected with those of the classes.*" It also contains a division of the hours of each day according to the studies thereof. From sunrise, and "*apres les matins,*" till 11 o'clock—the first of his recitation and lecture hours—he was to study Mathematics with the resolution "*Je ne toucherais pas aucun livre de belles lettres.*" From the hour for recitation till that for dinner he was to read newspapers, a reading that he continued till his death. No man in North Caro- was better acquainted with the useful news of the day. He was a constant reader of the *N. Y. Journal of Commerce*, paying special attention to its items respecting the sales of merchandise, and the coming and going of ships, that he might know what was being made and sold, and how it was transported to markets all over the world. So it came to pass that his knowledge of Geography was wonderful, for its extensiveness, minuteness, and accuracy. After dinner he was to study the Spanish language and Botany with this provision—"*Je ne toucherais pas aucun livre Anglais, a moins que les livres botaniques.*" On Saturday he was to busy himself with "*Greek, Latin, and Hebrew, and the History of Greece.*" One entry is, "*J'etais malade et Je lisais 80 lignes dans la traite de Cicero sur la vieillesse.*" This book contains Dr. Mitchell's notes on Newton's Principia, Hutton's Mathematics, Lacroix's Calculus, Vince's Fluxions, Montucla's History of Mathematics, Art. 'Optics' in the Perth Encyclopaedia," &c., &c. We have seen how Dr. Mitchell became a great Geographer. He made also a list of the years from "904 B. C., Troy taken" to "A. D. 1719, Biot commences his observations at the Shetland Isles." It was made that he might record, for each year, the events that rendered it remarkable in his eyes.

This constant recording of his observations as he read assured his becoming a trusty and universal Historian.

In 1825 Dr. Olmsted returned to Yale College. There he labored till his death and acquired a wide spread renown. Dr. Mitchell was then transferred to the Professorship vacated by Dr. Olmsted, while his own instructions were continued by the late Rev. Dr. James Phillips. Ardent as had been his pursuit of Science hitherto, it was hereafter much more absorbing—for Natural Science was connatural to him. His Botanical studies in North Carolina began at his first acquaintance with its hills and vallies, its woods and meadows. They closed only at the close of his life. For a memorandum about one of his later trips to the mountains of North Carolina shows that he carried with him "*a vasculum for plants, and a hammer for rocks.*" The MS. quoted above contains a list of flowers, mosses, oaks, hickories, maples, &c., which he had observed about Chapel Hill, and about Hillsborough. A most careful observer was Dr. Mitchell. His entries concerning his collections contain generally the date as well as the place of his discoveries—the remarks he noted on his specimens, criticisms of the descriptions in Pursh, Eliot, Michaux, Nuttall, &c., together with memorabilia touching points still doubtful. One page is headed—"*Catalogue of plants to be sent to Mr. Schweinitz.*" Here then we have the data by which a useful comparison may be made between the contents of the flora in this neighborhood at this time and sixty years ago. What was in the valley of Morgan's creek, from the whet-stone quarry, past McAulay's mill and Kittrell's—now Purefoy's—plantation, down to Scott's hole, what on the affluents of Bolling's creek—what on New Hope—what around Hillsborough, and what "beside Haw River," are recorded with much clearness. An examination of what is now in those localities might show what plants have been lost—what continued, and what introduced, even into the yards and gardens of Chapel Hill. The attention of the Mitchell Society is respectfully called to this good work. Its present Professor of Botany can doubtless spend—as his predecessor spent—and with the help of ardent and able pupils, may utilize many pleasant Saturdays by reviving these labors of love for Science.

Dr. Mitchell left no such evidence of his work in Mineralogy. But in his day it was well known to be equally broad and deep. He had a large collection of stones, and specimens of rock, gathered by himself, and sent by friends, from various parts of North Carolina. These—their names and their loci were very familiar to the Professor, and he introduced them fully and frequently to his pupils.

But unfortunately he labelled very few of them, and what he knew about them must be re-collected, because it cannot be recollected. But he was the principal authority, while he lived, as to the contents of the soil and sub-soil of our hills, and plains, and mountains. The light that the Mineralogy of State throws on its Geology, early engaged his attention. And he was in correspondence with Agassiz and other Scientists, to learn what their museums contained and how they explained the curiosities he sent them. It must be remembered that, to Dr. Mitchell, Mineralogy and Geology and Chemistry were juvenile members of the great family of Science. He knew them when puny inhabitants of the cradle and he helped to nurse them into their present vigorous growth, and that without the helps in Geography, Lithology, Petrology, and Biology that abound in our Modern Laboratories. Hence, while the larger features of the Geology of North Carolina were well known to him, he passed away from contemplating them before the bounds of its various deposits had been ascertained, and their relations to each other settled, and the upheaval of our mountains traced with the accuracy and fulness that marks the work of our accomplished Geologist, Dr. Kerr. Here let me remind the members of the Mitchell Scientific Society that as the first Astronomical Observatory in these United States was built at the University of North Carolina—so by a Professor of the same University, Dr. Mitchell's fellow-student and colleague, Dr. Olmsted, was planned and begun the first Geological survey of a State in our Union. Waddy Thompson, the brilliant Congressman from South Carolina, in conversing with Gov. Swain, gave North Carolina great credit for its early, consistent and persistent efforts in behalf of political liberty. But he complained that "*She has done nothing since.*" So also in Physical Science she has exhibited an early and intelligent desire for knowledge both theoretical and practical. But herein she has lost much of the ardor of her first love. Let it be the reward of the Mitchell Society that its labors have moved her to "repent and do her first works."

Besides "Notes on Natural History," and "Civil and Biblical History," intended to be guides for his students in their private studies, Dr. Mitchell published two editions of a Manual of Chemistry to be used in connection with his lectures and experiments. This was another department of Science wherein evolution was rapid all the time that Dr. Mitchell was a teacher therein. But he was in the front line of its progressives. His library and his laboratory showed that he withheld neither time, labor nor money to keep himself well informed concerning all that was a-doing throughout the world, in organic as well as inorganic Chemistry. Indeed the shelves of his Laboratory and of his ware-rooms fully illustrated the Chronology of Art in that Science. They contained what instruments had been useful as well as what were the fittest to survive. His oldest instruments, whether of metal or of glass, were almost all made in Europe. His latest, far simpler, more elegant, and more useful, were made in Northern workshops, or were the products of his own handiwork, guided by his own experience and reflection. We should not forget the difficulties that beset a Naturalist in North Carolina in Dr. Mitchell's time. During a great part of that time there was not a railroad in North Carolina, and the common roads were very vile. Travel through the State to visit a Botanical, a Geological, or a Mineralogical region was almost entirely in private conveyances. Books and Apparatus were sent forwards and backwards from Chapel Hill to Philadelphia, or New York, or Boston only through wagons to Petersburg, or New Berne, or Fayetteville, and thence by boats and schooners. In 1830 it cost more time and worry for Dr. Mitchell to get Chemicals, or an Instrument from Philadelphia than, in 1850, it did his successor from Berlin.

It is to be regretted that Dr. Mitchell's time as a student was divided by his labors as a teacher into parts so small, and so separate, that he could not engage in any work that demanded all his attention for a period longer than that afforded by a vacation of the University. He was much interested in the improvement of North Carolina—was always ready to give advice that was valuable, because of his large acquaintance within and throughout the State. The surveys for some of its roads he superintended in person. But these exertions were limited by his duties at the University. These he regarded as of paramount importance. Very rarely was Dr. Mitchell ever absent from his office at the beginning a college term, or from his seat at College Prayers, or from his desk in the lecture room, or from his duties in the pulpit, or from the weekly Faculty meeting. It was this conscientiousness, respecting duties imposed on him by authority, that circumscribed his original labors in the fields of Science, and rendered that fragmentary which otherwise might have presented a well ordered totality. A striking instance of this occasional working, and of the trouble which it caused, is to be found in the history of his examinations of the mountains of North Carolina. He had noticed that the Michaux—father and son, had both surmised that in our State, on the Grandfather, or the Black Mt., would be found the highest ground this side of the Mississippi. This conjecture was warranted by their finding among those heights Alpine plants which they had not seen south of Canada. So when, in 1830, Dr. Mitchell learned from Gov. Swain that Mr. Calhoun, of South Carolina, entertained the same opinion, because from that region rivers flow to all points of the compass, he resolved to verify these speculations by immediate and instrumental observations. But it was 1835 before he could begin to execute the plan he proposed for this verification. Michaux, the younger, had asserted that the Grandfather Mountain, which he climbed in 1794, and on the top of which he sang the Marsellais, was, "*La plus haute Montagne de toute l' Amerique Septentrionale.*" But Dr. Mitchell differed from the great Frenchman, and prepared to measure the Black Mountain by selecting its highest peak from Yeates' Knob, as did Prof. Guyot afterwards, in 1856. On the next day, July 28th, 1835, he ascertained the height of this peak, and in the same year published that it was "5,508 *feet above Morganton, or* 6,476 *feet above the level of the sea*"; Morganton being then thought to be 968 feet above the same level. Since 1835, Morganton has been found to be 1,200 feet above that base. So the measure of Mitchell's peak in 1835 should be regarded as 6,708 feet. The other measures of the same peak have been, by Dr. Mitchell, in 1844, 6,672 feet; by Gen. Clingman, in 1855, 6,941 feet; by Prof. Guyot, in 1856, 6,701 feet; by Major James Wilson, (with a spirit level) in 1857, 6,711 feet; and by the U. S. Coast Survey, 6,688 feet.

Dr. Mitchell measured other mountains in 1835, viz: Table Rock, The Grandfather, Yeates' Knob, Young's Knob, and the Roan. He visited the Black Mountain again in 1838, in 1844, in 1856, and in 1857, limiting his visit each year by the length of his summer vacation. In no one of these visits did he, or could he do all he wanted to do, or all he ought to have done. Hence he became doubtful concerning what he did in 1835 thinking that his guides had not led him to the peak he chose from Yeates' Knob. And he lost his life in attempting to dispel the doubts that were in his own mind, but almost no where else. Those who wish to see the evidence respecting the measuring of Mitchell's Peak in 1835 will find it in the number of the "University Magazine" for March, 1858, and in the Memoir of Dr. Mitchell published at Chapel Hill in the fall of the same year. At this time, when there are foot-paths and bridle-paths to almost every mountan height in North Carolina, it is difficult to realize the hardships undergone by Dr. Mitchell in 1835. The measuring of a mountain often cost him a suit of clothes, that of July, 1835, cost him a week's hard work besides. His way was often to where the boldest mountaineers had never trod, through, under, and over thickets of laurel, where only bears and snakes crawled before. One object before him in 1857 was to collect, in a southern latitude, corrections for barometrical observations on mountain heights. He proposed to connect the railroad survey across the Blue Ridge in North Carolina with the top of Mitchell's Peak by a series of stations differing from each other by 500 feet of altitude. He had sent one of Green's Smithsonian Barometers to be observed by Dr. Posey, in Savannah, Ga. Others were to be observed simultaneously in Asheville, N. C., at these stations on the sides of the Black Mountain and on Mitchell's Peak thereof. But this, with many other plans for the increase of Science, the welfare of the University, the honor of North Carolina were buried and lie with him in the lonely grave on the top of the mountain which he has consecrated.

Besides teaching in the lecture-room, Dr. Mitchell taught constantly from the pulpit. After he came to Chapel Hill, and throughout his life, very few weeks passed without his reasoning with his fellowmen concerning "Righteousness, Temperance and the Judgment to come." His sermons in the University Chapel abounded in apt illustrations of revealed Truth drawn from Natural Science, from History, and from Biography. In the village church his sermons and lectures were full of comparisons of Scripture with Scripture, and with the daily experiences of his hearers in private or in social life. For, in all his studies and in all his instructions, Dr. Mitchell was a Physicist rather than a Metaphysician. He scouted the notion that there is—that there can be any conflict between true Science and true Revelation. He rejected the doctrine of a *Natura maturans* by means of innate or connate forces, but proclaimed that of a *Natura maturata* by a Person who, after creating all things besides Himself, still works in all things, and by all things, according to the counsel of His own will. He judged that Miracles, as the seals of a Revelation, were possible, probable and historical. His descriptions of the wisdom, power, and goodness of God in His works of Creation and Providence were often connected with novel instances of his own observation, and were always striking—although addressed to the intellect rather than the emotions. For the redemption of mankind from its abyss of sin and misery he looked to the mystery of the Cross of Jesus Christ, inwrought by the Holy Ghost, and accepted by Faith. Ready at all times for every good word and work, his purse and his co-operation were never withheld from any reasonable and charitable undertaking. The poor, the widow, the fatherless and the stranger found in him a liberal benefactor.

'Although Dr. Mitchell used his pen freely in correspondence with his friends, and published, in the newspapers of the day, much information valuable especially to the citizens of North Carolina, it is to be regretted that he did not place his contributions to Science and Religion where they might have been more easily and permanently accessible to all Students of Nature. To the pages of Silliman's Journal, however, he contributed several interesting and instructive papers. E. g. In January, 1830, on A Substitute for Welther's Safety Tube, and on The Geology of the Gold Regions of North Carolina. In January, 1831, on The Causes of Winds and Storms. In April, 1831, An Analysis of the Protogæa of Leibnitz. In July, 1831, A reply to Redfield's criticism of his article on Winds and Storms. In January, 1839, Observations on the Black Mountains in North Carolina. After this time the great increase in the number of students at the University, and the consequent increase of his labors as Professor, and as Bursar, precluded such work as this. To the end of his life he was, nevertheless, a close observer and a frequent critic of what was going on in the world of Science, Religion, and Politics. His pamphlet on "The other side of the Book of Nature and the Word of God.' and a large quantity of unpublished MSS. showed that he was deeply interested in the discussions that preceded the war of Secession. Had he lived to see this great civil commotion, he would doubtless have manifested a deep sympathy with the people among whom he had cast his lot in the prime of his manhood.

Dr. Mitchell perished by falling from a precipice on the Black Mountain, on the night of Saturday, June 27th, 1857. He was descending the mountain alone to visit William Wilson, his faithful guide of 1835, whom he had not seen in twenty-two years. A storm on Mitchell's Peak delayed his descent so that his watch, when he was found, marked nineteen minutes past eight. He was found on the 8th of July by Mr. Thomas Wilson, the "big Tom Wilson" of Harper's Magazine, for November, 1857, who with some two hundred mountaineers was searching for Dr. Mitchell in every glen of that fearful mountain mass. He had fallen some forty feet into a deep pool in a branch of the Sugar Camp Fork of Caney River, not far from the route he had pursued with William Wilson in his first visit to those high places. He was buried first at Asheville, N. C., on the 10th of July, but afterwards, at the solicitation of many friends—but especially of the mountain men of Yancey county—his remains were removed on the 16th of June, 1858, to the top of Mitchell's Peak.

Such were some of the characteristics, and principal events in the life of Dr. Mitchell, one of the pioneers in Scientific research in these Southern States. "His bow abode in strength to the last, neither was his natural force abated." At the news of his death, men of Science marked the loss of a learned associate—while members of our National Cabinet and Ministers to foreign countries, Senators and Representatives in Congress, Governors of our States, with their Judges and their Legislators—Ambassadors from the court of Heaven, and men of reknown in all the liberal professions, distinguished Professors, with famous school-masters and hundreds of other pupils in the more retired walks of life rose up, in all parts of our country, to do honor to their revered preceptor. May his mantle of wisdom, energy, industry, learning, charity and piety rest on those at whose feet the young men of our country are now gathered, that they too may receive the plaudit :

"*Well done! Thou good and faithful servant.*"

DECOMPOSITION OF POTASSIUM CYANIDE.

J. F. WILKES.

Entomologists frequently find it convenient in killing insects to use a bottle containing moistened potassium cyanide over which plaster of paris is spread. The insect usually dies in a few minutes after enclosure in the bottle, the mixture assumes a brownish tint and the odor of hydrocyanic acid can easily be detected. As no explanation of this re-action could be found, some experiments were undertaken with a view to deciding the effect of the plaster of paris and how far it is necessary for the reaction.

To determine the nature of the gas given off, about one grain of pure potassium cyanide (only the chemically pure was used throughout these experiments) was placed in a test-tube, moistened with water and covered with a layer of plaster. Through an accurately fitting cork two bits of tubing entered this test-tube, one extending nearly to the surface of the mixed substances and having its other end connected with a washing flask containing a strong solution of iodium hydroxide; the other just entered the cork and was connected with a calcium chloride tube to which was joined a tube, 300 m m long, filled with murcuric oxide. A smaller tube from the end of this, dipped beneath a solution of potassium hydroxide. By means of an aspirator, air was drawn through this system of tubes slowly and at regular intervals for about two days. At the end of this time the potassium hydroxide was tested with the ferroso-ferric solution and no trace of prussian blue could be detected. The calcium chloride and mercuric oxide tubes were then removed and air once more drawn through into a solution of potassium hydroxide. On testing this the reaction for hydrocyanic acid with the ferroso-ferric solution was very clearly given. Here then was proof that hydrocyanic acid and no cyanogen was formed during the reaction. As a confirmatory test, however, hydrochloric acid was added to a portion of the potassium hydoxide through which the gas had been drawn, then sodium hydroxide, and it was heated to boiling. No ammonia could be detected. There was therefore no potassium cyanate present and hence no cyanogen had entered the liquid.

The aqueous solution of potassium cyanide can be kept unaltered in closed vessels at ordinary temperatures according to Pelouze and Geiger (Gmelin's Hand-book, vii, 415), but when boiled it is resolved into ammonia and potassium formate. It is well known that a strong smell of ammonia can be detected on opening a bottle containing moist cyanide, but we have seen no mention of the formation of hydrocyanic acid from the cyanide by simple decomposition without the aid of carbon dioxide or any strong acid. It was noticed during these experiments that when moistened potassium cyanide was enclosed in a test-tube and air aspirated over it for several days a slight but distinct Prussian blue test was given by the solution of potassium hydroxide through which the air after leaving the tube was drawn. Of course every precaution was taken to free the air from all traces of carbon dioxide or acid. It was made to pass through a wash bottle containing a concentrated solution of sodium hydroxide, then through two U tubes filled with small lumps of solid hydroxide, and lastly, fo have proof of the absence of carbon dioxide, through a small tube containing limewater, passing thence into the tube containing the cyanide. This experiment was repeated at various temperatures ranging from 12°—18° c. and always with the same result. If the amount of moisture was small the depth of color gotten in the ferroso-ferric test was slight. If about 1 c.c.

of water was used to 1 gram of the cyanide a clear deep green was gotten. With calcium carbonate, ordinary hydrated calcium sulphate or barium sulphate, the cyanide when mixed in about equal parts and moistened gave off apparently about the same amount of hydrocyanic acid as when alone, judging from the depth of color in the ferroso-ferric test. With the anhydrous sulphate a distinct blue was gotten, showing a decidedly increased decomposition, and in this case the mixture left in the tube had a purplish brown color which was not observed with the others.

Since other sulphates and other calcium compounds failed to act on the potassium cyanide and no change in the anhydrous sulphate itself could be detected, it seemed probable that its action was due in some way to its power of combining with a portion of the water present to form the hydrated sulphate. When an excess of water 3–5 c.c. was added to the mixture of the cyanide and the anhydrous sulphate the test showed very little, if any, more hydrocyanic acid to be given off than when the hydrated sulphate or the cyanide alone was used and no discoloration was produced. When barely moistened the evolution of hydrocyanic acid was considerable. If porous, partially dehydrated calcium chloride was added to the cyanide in the place of the sulphate the amount of acid evolved was still greater and the color of the mixture almost black. Anhydrous sodium carbonate had the same effect, though in a lesser degree. Again, when the cyanide and the plaster had both been carefully dried, the air was drawn over them for four days and no hydrocyanic test could be gotten in the final tube of potassium hydroxide.

The mixture of potassium cyanide and anhydrous calcium sulphate left after two or three days of aspirating was examined and to contain potassium hydroxide. The reaction then is probably

$$KCN + H_2O = HCN + KOH.$$

It has been shown by Karsted (Poggendorff's Annalan, 115, 348) and Storer (Amer. Chem. Journal v. 69) that where air alone comes in contact with corks and organic connectors carbon dioxide is formed. This would probably account for decomposition when potassium cyanide and water alone were used, but the greatly increased depth of test when plaster of paris is added shows a decided action on the part of that body.

Chemical Laboratory, U. N. C., Nov., 1883.

REVERSION OF PHOSPHORIC ACID BY HEAT, TOGETHER WITH SOME OBSERVATIONS ON THE FINE GRINDING OF ANALYTICAL SAMPLES.

W. B. PHILLIPS, PH. D.

When manufactured Phosphates are analyzed immediately after preparation, the percentage of Phosphoric acid soluble in water is generally found to be higher than at any subsequent time. A portion of it becomes insoluble in water, but is soluble in some of the organic salts of Ammonia; i. e., in the oxalate, and citrate. To this Phosphoric acid the term Reverted is applied, signifying, as is well known, Phosphoric acid which, though at one time soluble in water, has become insoluble in that liquid, and occupies an intermediate position between the original tri-calcium-phosphate of the crude material, and the tetra-hydrogen-calcium-phosphate of the manufactured product.

The change from Soluble to Reverted begins almost at the very moment of manufacture, and continues for an indefinite period, varying among other things with the raw material used, the quantity of acid employed, &c., &c.

It might be supposed that as this reversion begins when the product begins to dry, it was connected intimately with the process of drying. But it has been shown by Post (Chem. Industr. 1882, p. 217,) that it goes on even in samples enclosed in hermetically sealed bottles, and hence is not dependent on the loss of moisture, under ordinary conditions of temperature.

The limits of this paper will not allow me to enter at all into the discussion of the various causes of reversion. Among the more prominent ones are the presence of unattacked oxides of Calcium, Iron, and Aluminum, and Calcium Sulphate and Carbonate.

The object of this paper is to direct attention anew to the fact that a temperature of 100° c maintained for varying lengths of time on the manufactured phosphates causes a very rapid reversion.

The material used was a sample of an "Acid Phosphate" prepared under my personal supervision at the works of the Navassa Guano Company. It was prepared as follows:

Fine ground Charleston Rock,	- - -	1,100 pounds.
Sulphuric Acid, 470 B	- - - - - - - -	950 "

Several tons of it were made November 21st, 1883, and a sample of it was drawn by myself November 22d. The sample was pulverized by hand as fine as possible, and analyzed at once.

Fifty grains of the sample were then taken and dried at a temperature of 90°–100° C. for two days. At the end of that time a sample was drawn, pulverized until it passed through a sieve of 100 meshes per square inch, and analyzed.

The drying was continued for eight (8) days longer, at the end of which time a sample was drawn, passed through a 100 mesh sieve, and analyzed.

Tabulating these results for convenience of reference we have:

On a dry basis.	A. 24 hours after preparation, pulverized by hand.	B. After 2 days at 90°–100° c. Through 100 mesh sieve.	C. After 10 days at 90°–100°c. Thro' 100 mesh sieve.
Total Phos. Acid	17.31 per cent.	17.13 per cent.	17.32 per cent.
Soluble " "	11.74 " "	10.59 " "	7.48 " "
Insoluble " "	3.32 " "	2.95 " "	2.85 " "
Reverted " "	2.25 " "	3.59 " "	6.99 " "
Available " "	13.99 " "	14.18 " "	14.47 " "

We have here a loss of 4.26 per cent. of Sol. Phos. acid in days, a loss of .47 per cent of Insol. Phos. acid, and a gain of 4.74 per cent. of Reverted. Ordinarily the loss of Soluble is compensated by the gain of Reverted, while the Insoluble remains about the same. Post, in the article before referred to, claims to have found that in the course of six (6) months, in sealed bottles, some of the Soluble becomes so Insoluble as not to be dissolved by Am. Citrate at 90° C. But here it is shown that in ten (10) days at a temperature of 90—100° C. Some of the originally Insoluble Phos. acid, viz: .47 per cent. has *become Soluble in Am. Citrate at 40° C.*, that is, has changed to Reverted! But this loss of .47 per cent. of Insol. Phos. acid is doubtless due to the very fine grinding of the dry samples. For the difference in Insol. Phos. acid between the first and second analyses is .37 per cent., while the difference between the second and third is only .10 per cent. That is to say, the difference between the Insol. Phos. acid in the sample pulverized by hand, and the sample dried for two (2) days and then passed through a 100 mesh sieve is .37 per cent. in favor of the finely pulverized.

But the difference between the two finely pulverized samples after eight (8) days of drying is only .10 per cent.

That the Am. Citrate should dissolve more Phos. acid from the finely ground sample is just what was to be expected. When sufficient Sulphuric acid is added to the crude Tri-calcium Phosphate to render *all* of the Phosphoric acid Soluble in water reversion does not appear to proceed as rapidly as when there is present some of the original undecomposed phosphate. But in this case, when using Charleston Rock, it is very difficult to obtain a product which will dry in a reasonable time without the aid of artificial heat, or some carbonate as a dryer. Using artificial heat there is great danger of hastening reversion, and the same is true if some chemical "dryer" is used, to say nothing of the reduction of the content of total Phosphoric acid in this latter case.

There is one point to which I wish to direct especial attention, and that is what I conceive to be the *necessity for fine grinding of the analytical sample.* Plants derive their food from the soil in solutions, and in these solutions the food is in a state of almost inconceivable fineness.

In estimating the value by chemical analysis of any plant food, we should, as far as practical, approximate to the degree of fineness to which the food must be reduced before the plant can use it.

Other things being equal, the finer we grind analytical samples before acting upon them with chemical reagents which in a greater or less degree represent the action of the soil the nearer do we approach to the methods of nature.

Laboratory of Navassa Guano Company,
Wilmington, N. C., Dec. 6th, 1883.

ANALYSIS OF CHAPEL HILL WELL-WATERS.

E. A. DESCHWEINITZ, A. B.

The samples examined were drawn during the months of October and November, 1883. The methods of analysis given in Cairns were followed, as a rule. The oxidizable organic matter was roughly determined by titration with potassium permanganate. The results are calculated in grains to the gallon and for purposes of comparison certain published analyses are appended.

I is the Campus well; II the well at President Battle's; III the well at Hon. John Manning's; IV the well at Dr. Venable's; V the well at Mrs. Hendon's; VI the well at Dr. Phillips'; VII is calculated from the analysis of a pure spring in Surrey, England, published in Watt's Dictionary; VIII is a spring, less pure, from Yorkshire, England; IX is the lake of Geneva; X is rain-water.

	I	II	III	IV	V	VI	VII	VIII.	IX
Na Cl	.873	.416	9.908	2.320	2.264	3.283	.722	43.246	----
K Cl	----	----	.260	.128	.261	.141	.327	----	----
$Na_2 So_4$	----	.211	----	----	----	----	----	----	----
$K_2 So_4$	----	----	----	----	.003	----	----	1.078	----
$Na_2 Co_3$	1.121	.212	----	----	----	----	----	38.414	----
$K_2 Co_3$	.084	.303	----	----	----	----	trace.	----	----
$Mg So_4$	----	----	.227	.092	----	.253	trace.	----	2.465
$Mg Cl_2$	----	----	.106	.359	----	1.235	----	----	.504
$Mg Co_3$	.486	.210	3.066	.987	.583	----	----	.656	----
$Ca Co_3$	.420	.905	4.485	7.740	1.220	9.005	----	1.767	4.693
$Si O_2$	2.493	.666	1.942	2.841	2.963	2.676	.829	1.525	.058
Oxidizable	----	----	----	----	----	----	$Ca So_4 = .899$	.185	$Ca So_4 = .746$
Org. mat.	.438	.279	.162	.138	.162	.579	.754	----	----
Total	5.915	3.202	19.956	14.603	7.456	17.172	3.34[illegible]	87.243	8.466

X. Organic matter .040

Chemical Laboratory, U. N. C.,
January 12th, 1884.

ACTION OF AMMONIA HYDRATE UPON LEAD CHLORIDE.

JULIAN WOOD.

The lead chloride for these experiments was gotten by precipitating pure lead nitrate with hydrochloric acid. The precipitate was thoroughly washed and dried. To about 7 grains of this chloride 140 c.c. of ammonia solution was added, the mixture being heated then some six hours upon a sand bath. The residue was washed, dried and analyzed with the following results :

I. .6200 grams of substance gave .3585 grams AgCl. p. c. Cl.=14.20. The water was determined and Cl. calculated on a dry basis=14.68.

II. .5003 grams of substance gave .2950 grams AgCl. p. c. Cl.=14.57. No water in the specimen.

III. .5650 grams of substance gave .3265 grams AgCl. p. c. Cl.=14.29. Calculated water free=14.54.

IV. 1.3345 grams of substance gave 1.5340 grams $PbSO_4$ p. c. Pb. 78.52. Free of water=81.14.

V. H_2O in air-dried substance=3.33 p. c.

				I.	II.	III.	IV.	V.
Pb_2	calculated p. c.	82.56	found p. c.				81.14	
O	" "	3.31	" "					
Cl_2	" "	14.13	" "	14.68	14.57	14.54		
H_2O	" "	3.46	" "					3.33

Again between ten and eleven grams of the chloride was heated wth 175 c.c. ammonia solution for twelve hours on a water-bath, then washed and dried as before.

I. .145 grams of substance gave .0525 grams AgCl. p. c. Cl.=8.61. Water-free=8.70.

II. .4935 grams of substance gave .1490 grams AgCl. p. c. Cl.=7.48. Water-free=7.56.

III. .5035 grams of substance gave .1594 grams AgCl. p. c. Cl.=7.81. Water-free=7.89.

IV. 1.5353 grams of substance gave 1.9420 grams $PbSO_4$ p. c. Pb=86.31. Water-free=87.26.

				I.	II.	III.	IV.
Pb_4	calculated p. c.	87.53	found p. c.				87.26.
Cl_2	" "	7.48	"	8.70	7.56	7.89	
O_3	" "	4.99					

These two experiments then would point to the formation of two entirely different bodies, the first having the formula $PbCl_2 . PbO . H_2O$., the second the formula $PbCl_2 . 3PbO . H_2O$.

To test the correctness of these results two equal amounts of the chloride (about five grams) were taken, ammonia solution added and the two then heated, one upon sand-bath and the other upon water-bath. As the one on the sand-bath was kept at a brisk boil, evaporation was faster and more of the ammonia had to be added to replace that which was thus lost. Hence to the chloride upon the sand-bath 145 c.c. were added, whereas 65 c.c. sufficed for that heated on the water-bath. The object was to keep the ammonia solution strong enough to give always a decided ammonia smell. Once or twice, however, that upon the sand-bath became very weak.

The residue from the sand-bath mixture was washed. The substance was creamy yellow and was unchanged by heating up to 200° C.

I. .5060 grams of substance gave .2745 grams AgCl. p. c. Cl.=13.41
Water-free=13.89.

II. 1.2700 grams of substance gave 1.4730 grams $PbSO_4$ p. c. Pb=78.45
Water-free=81.26.

				I.	II.
Pb	calculated p. c.	82.56	found p. c.		81.26
Cl_2	"	" 14.13	" "	13.89	
O	"	" 3.31	" "		

The formula then is $PbCl_2$. PbO.

The residue from the water-bath was much yellower and became a deep yellow on heating. The analysis gave the following results:

I. .520 grams of substance gave .1370 grams AgCl. p. c. Cl.=6.51
Water-free=7.28.

This corresponds with the per centage of chlorine calculated for the tribasic chloride $Pbcl_2$. 3Pbo.

As Mr. Wood had to leave the research at this point, further inquiry into this formation of the oxysalts of lead was left to Mr. Borden, who contributed the next paper.

Chemical Laboratory, U. N. C., Feb. 9, 1884.

EXAMINATION OF IRON ORES FROM CHAPEL HILL MINE.

J. C. ROBERTS.

The samples were not selected so as to give the commercial value of the mine but were chosen to illustrate the different grades of the ore and its decomposition so far as possible. The samples taken were as follows: 1° A fairly compact Brown Hematite; 2° A crumbling, siliceous, nearly decomposed ore; 3° Fairly compact, purplish brown; 4° Compact, representing mass of ore; 5° Very compact, showing crystalline structure; 6° Compact and siliceous; 7° Compact and siliceous; 8° Very compact. As to magnetic properties, 1° was not at all magnetic—2, 3, and 4 very slightly so—5, 6, and 7 rather more magnetic—8 decidedly magnetic. The general character of the ore is compact, crystalline with a slight action upon the needle. Tests were made for titanium and chromium but none found in the specimens examined. The solubility (relative) was tested by putting a gram of each ore in a small loosely stoppered flask, covering with 5 c.c. of hydrochloric acid (Sp. Gr. 1.15) and heating on a sand-bath two hours. All were heated at the same time, so the same temperature was maintained as nearly as possible. As a rule, the methods recommended in Cairns' Quantitative Analysis were followed for the various determinations. In the column headed "Solubility," the figures show what percentage of the total amount of iron present was dissolved.

Specimen.	Spec. Grav.	p. c. Fe.	p. c. Sio$_2$	p.c. H$_2$o	p.c.S.	p.c. P	p, c. Mn.	p. c. Al$_2$o$_3$	Solubility.
1	3.19	46.47	21.35	11.96	.25	.06	none.	none.	100.00
2	3.74	46.07	29.81	.40	traces	.01	none.	3.97	100.00
3	4.16	50.45	22.60	1.26	.09	.05	none.	3.93	100.00
4	4.30	57.41	17.09	.72	.03	none.	none.	none.	90.16
5	4.79	61.99	--------	--------	-----	-----	--------	----------	63.31
6	3.74	39.94	--------	--------	-----	-----	--------	----------	95.89
7	3.70	37.48	--------	--------	-----	-----	--------	----------	85.64
8	4.45	52.71	25.65	--------	-----	-----	--------	----------	------

The figures for the percentage of silica were gotten by analysis only in the case of Nos. 4 and 8. In the other cases they were gotten by difference. Nos. 5, 6 and 7, were determined only so far as the iron was concerned, since they seemed merely siliceous varieties of No. 4. In No. 8 the silica is probably a little high as the ore is somewhat magnetic. The difficulty of reaching exactly the same conditions with this ore (No. 8) prevented a determination its relative solubility.

Chemical Laboratory, U. N. C., February, 1884.

NOTES ON THE TORNADO WHICH OCCURRED IN RICHMOND COUNTY, N. C., FEBRUARY 19TH, 1884.

J. A. HOLMES.

It will be remembered that on February 19th of the present year (1884), occurred an extensive series of tornadoes, which beginning at their western limits during the early morning hours, as the day advanced moved in a general easterly and northeasterly course through parts of Missouri, Kentucky and Tennessee, and from Mississippi through Alabama, Georgia, South Carolina, North Carolina, and into Virginia. Tornadoes occurred in South Carolina between the hours of about 5 and 10 o'clock p. m.; in North Carolina between 9 and 11 p. m.; and in Virginia about 12 o'clock midnight.

At the time of the occurrence of the tornadoes in the Carolinas, the general storm center (region of barometric minima) was passing over the central portion of Lake Huron. Around this center the isobars were so disposed as to form a somewhat irregular oblong barometric trough, the major axis of which was extended in a nearly north and south direction. At this time over the central Mississippi Basin, and as far South as Atlanta, the winds were from the northwest; in the southeast portion of the Basin these winds turned toward the east. Along the South Atlantic Seaboard from Savannah to Cape Hatteras, the winds moved from the ocean in a general northerly course. The winds from the northwest were cold—those from the south were warm and moist; and whether this fact may or may not have been an important factor in producing the tornadoes, it was over the region of country where the meeting of these winds took place that the series of violent tornadoes occurred.

The tornado to be considered in this paper occurred in Richmond county, N. C.,—passing near Rockingham and continuing a northeast course beyond that town. In loss of life it proved to be the most destructive tornado recorded as having occurred in the State. Eighteen persons were killed at the time and seventy-five wounded; loss in property estimated at $10,000. The writer visited the path of this tornado one week after the occurrence storm, and examined about ten miles of it, including the portion of over which the destruction was greatest.

The first appearance of destructive work by the storm, so far as I was able to learn, is just east of the Peedee River, about six miles below the Carolina Central R. R. Bridge. From this place the storm moved on toward the northeast, passing within one mile of the town of Rockingham, eight miles distant. From such information as could be obtained, I concluded that not until the storm had reached the vicinity of Rockingham, did it assume the character of a tornado; the destructive work was described as slight and irregular; at this point, however, and for about eight miles on toward the northeast, the destructive work was great, and there can be no doubt but that the storm in passing over this region developed into a true tornado. The path for three or four miles before its northeast end was reached was reported as showing evidence of a decrease in the violence of the storm, and the disappearance of the tornado characteristics.

As to topography, the surface of the country over which the storm passed was undulating, and in places somewhat hilly. From the river to the region about Rockingham, there was a rise in the path of the tornado of about 150 feet. From this point onward the general surface of the country was more nearly on a level; but the path of the tornado was crossed by several small and irregular valleys, cut down from 50 to nearly 100 feet below the general level. These irregularities seem neither to have modified the violence, or to have changed the direction of the storm.

The character of the path of the tornado varied considerably over different points of its course. The writer's observations begun on the path about 1½ miles to the south of Rockingham. At this point no great destructive work had been done. The storm had passed over a cultivated field and entered a forest of old field pines, trees 30 to 50 feet high. An occasional tree had been blown over, and on both sides of the centre of the storm path these trees lay with their tops in the direction the storm was moving, but inclined toward the centre—at angles with the direction of the path varying from 20° to 75°. I could not find at this point any evidence of a whirling wind, nor was any such indication observed until the path had been followed into the pine forest for the distance of ¾ of a mile. Here, a few hundred yards south of the C. C. R. R., near the centre of the path, over an area of about two acres, every tree had been blown over. The total width of the path at this place was about 550 yards. The forest around was rather dense, and but comparatively few trees had been disturbed. In this central space, however, the trees were piled upon one another in seemingly great confusion. Examination showed that in most cases the trees at the bottom (the first to fall) had fallen toward the northwest, and (on the north side of the path) even toward west northwest, while those on top had fallen toward the northeast. Even on the northeast side of this cleared space just alluded to, the larger portion of the trees were left standing, for the distance of some 300 yards, where the storm crossed the C. C. R. R.

Near the railroad the storm crossed a ravine, and then ascended a gentle slope, and moved on partly through cleared fields, and partly across groves of trees, over somewhat hilly ground, for a distance of about two miles, retaining its width of about 500 yards. Over this distance, there was abundant evidence of an increasing violence of the storm. Every house in the path had been torn down, even to its foundations. Oak and hickory trees, 8 to 12 inches in diameter, had been broken or twisted off at 6 or 8 feet above ground. Beyond, the course of the tornado passed through an extensive forest of Longleaf pines, thinned out in places, and occasionally interrupted by a cleared field. Through this forest extended a road, and on both sides of this road extending in a general northeast course, were located the negro cabins which made up the town of Philadelphia. As many of these cabins were located on the ground passed over by the storm, all such were torn down and many lives lost.

It was along through this region, in the position of the fallen pines and the scattered debris from the houses, that the general spiral movement of the winds—in a direction opposite to that of the hands of a watch—was more clearly shown. Near the beginning of this region, the path of the storm rapidly widened out from 500 to 1,500 yards. And for a distance of five miles very few trees of any size were left standing in the storm's path. There was, too, a good deal regularity in the positions occupied by the fallen trees; especially on the south side, and across the centre of the path, the trees nearly all lay parallel to one another. The positions are shown by a cross section of the path; distance in yards indicating the distance from the southeast side. Starting from the southeast side and going directly across toward the northwest, at right angles to the course of the path, for the first 400 yards, trees lay toward the north northeast.

Between 400 and 800 yards trees lay toward the north.

At 800 yards trees lay toward the north northwest.

At 900 " " " " " northwest and others w. n. w.

At 1000 yards trees lay toward the northwest.
At 1100 " " " " " west.
At 1150 " " " " " w. s. w. and s. w.
At 1200 " " " " " s. s. w.
At 1300 " " " " " s., s. e. and s.
At 1400 " " " " " s. e.
At 1500 " " " " " e.

For the remaining 75 to 100 yards, to the extreme left (n. w.) side trees lay toward the east. Observations made at several different points along the path of the storm showed that generally the trees on the right (s. e.) side of the path had fallen in directions varying from north to northeast, while on the extreme left (n. w.) side of the track, their directions varied considerably. Over the section of the path where the storm seemed to have assumed the form of a true tornado, the trees, within a distance of from 100 to 200 yards from the left side of the path, lay in directions varying from east to southeast, and generally between 200 and 300 yards from that side, (about the line of meeting between the whirling wind and the inflowing current from the west) the trees lay more toward the south—while over portions of the path where there was little or no evidence of the whirling movement, the trees lay toward the north or northeast.

The "tornado centre," in every case where its position could be determined, (as is usual in tornadoes) was found to be much nearer the left (n. w.) than the right (s. e.) side. In the cross sections of the path made at different points, the distance of the "centre" from the left (n. w.) side was found to be equal to one-third the total width of the path. And in one case where there was no whirling motion of the storm, the line along which the two wind currents met, as indicated by the position of trees and debris, occupied about the same relative position as to distance from the two sides of the storm path.

One noticeable feature about the path of the storm, especially that section over which the storm was most violent, was the evidence of a strong wind having followed the tornado blowing in the direction that the tornado was moving. Over a space along which must have been the tornado centre, varying in width from 100 to 200 yards, the trash, light timbers, and sand were piled up against the southwest side of trees that had fallen across the track toward the northwest. The soil in many places looked much as though it had been washed over by running waters. Some heavy logs and timbers appeared to have been rolled considerable distances toward the northeast, after the trees had been blown down. The violent "after blow" causing all this, I suppose to have been due to the fact that the wind immediately behind the tornado, blowing from the southwest, would rush in to join the whirling and rising current.

The width of the tornado path, as already indicated, varied from 500 to 1600 yards. Over the eight miles of the path where the storm was most violent, the width varied from 1200 to 1600 yards. The region of greater violence extended from 200 to 300 yards to the left (n. w.), and from 400 to 500 yards to the right (s. e.) of the "centre." What is called the "tornado centre," so far the region over which this passed could be identified, while varying in width and appearance, seemed to have been more generally between 100 and 200 yards wide.

The total length of the tornado path, so far as information could be obtained, was about twenty miles.

The exact time of occurrence of the tornado could not be learned, but general testimony showed that the storm passed Rockingham at about 10 o'clock p. m. The time of starting or time of ending of the tornado could not be learned; and hence the rate of the progressive movement could not be estimated. The length of time consumed by the tornado in passing by any one place after its front had reached such place was generally estimated, by those exposed to the storm, as being less than one minute.

With regard to the appearance of the tornado cloud, and the atmospheric conditions preceding and accompanying the storm, it was difficult, and in many cases impossible, to obtain satisfactory information, owing, in part at least, to the fact that (1) the tornado occurred at night, and (2) the people exposed to the storm were principally negroes, who were too badly frightened to observe closely what was taking place about them. Summing up the best evidence taken, the following seems to be as nearly correct as the report could be made: During the two or three days preceding February 19th, nothing was noticed about the weather that was considered peculiar or at all unusual. On the night of the 17th a light rain fell in the vicinity of Rockingham. The 18th was a generally open day, a few clouds in the morning disappeared later in the day—winds not violent, generally from west and southwest. The morning of the 19th (day of the storm) nothing unusual—wind brisk, but not violent, generally from the west. Between one and two o'clock p. m., wind changed to southwest, and became some stronger; heavy clouds began to form in the southwest, and distant thunder was heard in that direction. During the afternoon, wind increased in strength, and continued to blow from southwest. The clouds in the southwest increased in amount, and thunder became more distinct. At evening twilight, wind from southwest was strong, but not violent, of medium temperature; light clouds had pretty well covered over the heavens; heavy, dark clouds were still banking up in the southwest; thunder distant, heavy and rolling; flashes of sheet lightning frequent. From dark until the time of the storm (about 10 p. m.) the wind continued about the same in direction, strength and temperature. The lighter clouds were continuous over head, and the dark clouds of the southwest were increasing in extent, and in their threatening appearance, and were rising higher above the horizon. Between 9 and 10 o'clock p. m., the dark storm cloud appeared to increase more rapidly in its dimensions and to move toward Rockingham from the southwest. As observed by several gentlemen living seven or eight miles to the northwest of the storm path, the cloud (which was rendered visible by the almost continuous flashes of lightning) appeared to move about as rapidly as an ordinary thunder-cloud. Beneath its under surface the smaller fragments of cloud ("racks") were moving rapidly about in almost every direction, ("boiling up") showing great disturbance. One gentleman living several miles to northwest of the track, and watching the cloud as it appeared several miles to the southwest of Rockingham, observed a distinct funnel shaped mass extending down from the under surface of the main cloud, with its lower and smaller end still some distance above the horizon, and moving from side to side. Over that portion of the path where the storm proved to be most destructive, many persons who were in the path, described the cloud as being all about them on the ground.

The noise accompanying the storm resembled that of heavy trains of cars running at high speed. This noise was accompanied by frequent and heavy rolling thunder.

The exhibitions of electricity were great and varied. Flashes of sheet lightning were so frequent and brilliant that several persons stated that they could almost have read by the light. "Balls of fire," and "lamps" in the cloud were described as having been seen by a number of persons. One gentleman of acknowledged integrity and character, who lives several miles to northwest of the storm's path, described to the writer one of these "balls of fire" as an illuminated portion of cloud, which appeared to be 15 to 20 feet in diameter, and about as bright as the moon, looked at through a "light fog or cirrus cloud." This phenomenon was watched for several minutes, as it moved along at the front edge of the storm cloud.

Falling hail was observed to precede the whirling winds of the tornado by a few seconds, and the hail with some rain continued to fall for 15 or 20 minutes after the storm had passed. Hailstones were generally small.

At no time before the storm was there any notable change in the temperature of the air, or peculiar conditions of the air which gave rise to "difficult breathing," or "feeling of suffocation," sometimes experienced by those exposed to the violence of such storms. After the storm, the wind continued to blow from the southwest as a strong wind, but not violent. As soon as the storm had passed, the temperature of the wind began to fall, and it soon became "chilly," and cool, continuing so until morning.

It is to be regretted that exact temperatures, and variations in the atmospheric pressure were not observed or recorded, either before or after the storm.

The lateness of the hour at which the tornado occurred is worthy of note. It must have started at some time between 9 and 10 p. m., and have stopped at some time between 10 and 11 p. m.; whereas such storms do not often occur after 7 or 8 p. m.

Mention of the other tornadoes which occurred in this State about the same time as the one herein described, is omitted from the present paper, for the reason that the regions over which they passed have not been examined by the writer, and further, the facts concerning them are to be published by the U. S. Signal Service Bureau.

Chapel Hill, N. C., March 8th, 1884.

MONTHLY AND YEARLY MEANS OF THE FAHRENHEIT THERMOMETER FOR SIXTEEN YEARS, AT CHAPEL HILL, N. C.

Observed by Rev. James Phillips, D. D., Professor of Mathematics and Natural Philosophy.

Months.	1844.	1845.	1846.	1847.	1848.	1849.	1850.	1851.	1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	Sums.	Means.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
Jan..........	38 19	45.76	41.78	41.68	43.98	40.94	45.20	42.23	36.02	40.01	40.70	41.79	28.89	28.45	41.46	40.98	610.96	40.06
Feb..........	42.97	46.29	40.92	41.50	43.36	38.07	40.05	49.21	45.58	46.63	45.31	36.10	37.01	50.95	36.79	45.18	690.22	43.14
Mar..........	50.03	52 44	52.41	47.92	50.25	51.70	48.46	52.14	53.72	49.79	51.77	41.57	43.99	45.58	46.61	51.35	796 77	49.80
April..........	66.06	67.72	60.93	60.70	58.13	58.35	55.20	58.54	56.49	60.14	56.88	64.03	61.51	52.09	58.83	59.23	951.86	59.68
May..........	73.40	68.03	70.48	63 80	68.96	65.75	63.83	68.04	68.84	66.44	68.70	67.73	67.27	66.27	68.01	68.20	1083.12	67.71
June..........	75.49	60.75	73.71	72.12	71.62	76.61	73.38	72.82	72.51	73.43	75.93	71.11	77.28	76.85	69.83	73.69	1162.86	72.68
July..........	81 29	81.19	76.45	74.50	76.16	71.11	78.51	79.46	77.45	77.45	81.07	80.20	81.87	75.84	79.05	78.22	1252.55	78.28
Aug..........	76.34	77.65	77.39	72.93	71.23	75.36	76.90	75.05	73.21	76.37	78.30	76.68	76.11	77.50	78.58	75.13	1217.73	76 11
Sept..........	70.67	71.57	73.11	68.85	68.17	68.52	70.08	68.07	67.78	69.66	71.90	73.56	70.36	71.63	67.77	70.79	1125.82	70.31
Oct..........	58.16	58.71	57.96	58.72	60.40	57.80	58.69	59.47	62.88	54.27	62.25	58.50	58.78	56.08	62.03	56.96	941.39	58.84
Nov..........	52.60	49.95	52.43	41.22	46.58	55.60	51.95	48.92	47.98	53.39	49.17	53.87	49.88	47.51	45.93	52.49	810.47	50.65
Dec..........	42.12	35.02	45.51	43.63	53.08	42.71	45.26	39.44	46.00	40.51	39.51	43.50	38.59	47.18	46.69	41.65	699.71	43.17
Means..........	60.61	59,67	60.28	58.71	59.82	58.72	58.96	58.25	59.04	58.93	60.66	58.77	57.63	58.02	59.30	59·71	949.11	59.32

MONTHLY MAXIMA AND MINIMA FOR THE SIXTEEN YEARS—1844-1859.

	1844.	1845.	1846.	1847.	1848.	1849.	1850.	1851.	1852.	1853.	1854.	1855.	1856.	1857.	1858	1859.
Maxima..........	July ° 81.29	July ° 81 19	Aug. ° 77.39	July ° 74.50	July ° 76.16	Jun. ° 76.61	Aug. ° 76.90	July ° 79.46	July ° 77.45	July ° 77.17	July ° 81.07	Jun. ° 80.20	July ° 81.07	Aug. ° 87.50	July ° 79.05	July ° 78.22
Minima..........	Jan 38.18	Dec. 35.05	Feb. 40.92	Jan 41.68	Feb. 43.36	Feb. 38.07	Feb. 40.05	Dec. 39.44	Jan. 36.02	Jan. 40.01	Dec. 39,51	Feb. 36.10	Jan. 28.89	Jan. 28.45	Feb. 36.79	Jan. 40 98

A TABLE OF HIGHEST AND LOWEST THERMOMETERS AT CHAPEL HILL, N. C.,

Together with the Dates and Degrees of the Highest and Lowest Daily Means of Thermometer for Six Years—1854-'59—as observed by Rev. Dr. James Phillips.

Years.	Highest Therm.		Lowest Therm.		Warmest Day		Coldest Day.	
	Date.	Ther.	Date.	Ther.	Date.	Ther. Mean.	Date.	Therm. Mean.
1854.	June 30 } July 6 }	100°	Jan. 24	16°	July 5	89.60°	Jan. 9	26°
1855.	April 19	102°	Feb. 27 } Feb. 28 }	18°	Jun. 30 } July 19 }	86.67	Feb. 28	25
1856.	July 30	105°	Feb. 4	5°	July 30	92.67	Feb. 4	5
1857.	Aug. 17	99°	Jan. 23	1°	Aug. 15	87.67	Jan. 23	10.6
1858.	Aug. 11	98°	Mar. 3	18°	June 30	86.67	Mar. 3	25
1859.	July 18 } July 22 }	99°	Jan. 23	13°	July 18	89.67	Jan. 23	18.7

RAINFALL AT CHAPEL HILL FOR FOUR YEARS.

Years.	January	February.	March	April	May.	June.	July.	August	Septemb'r	October.	November	December.	Sums.
	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
1856.	......	.. ..	....	1.656	3.835	2.369	1.454	3.788	7.460	2.777	3.740	....	....
1857	2.811	0.139	2.304	2.792	4.381	2.536	4.403	3.656	....	....	2.766	4.931	....
1858.	2.596	5.280	2.817	2.763	2.405	3.751	6.148	2.716	4.115	1.947	3.293	6.009	43.941
1859.	3.126	3.353	5.281	3.435	3.659	0.602	3.946	5.686	4.069	2.239	2.704	2.981	42.171

A TABLE OF MONTHLY MEANS OF THE BAROMETER FOR SIX YEARS,

As Observed by the Rev. Prof. James Phillips, D. D., at Chapel Hill, N. C.

Months.	1854.	1855.	1856.	1857.	1858.	1859.	Sums.	Means.
January	30.157	30.076	30.001	30.161	30.204	30.279	180.896	30.149
February	30.142	29.973	29.948	30.175	30.122	30.134	180.494	30.082
March	30.041	29.956	29.953	30.031	30.110	30.010	180.10L	30.016
April....	30.029	29.991	30.063	29.924	29.986	29.986	197.979	29.996
May	29.975	29.946	29.897	29.918	30.046	30.096	179.898	29.983
June	29.927	29.920	29.920	29.856	30.074	30.200	179.897	29.983
July........ .	29.972	29.983	29.941	29.937	30.044	30.075	179.952	29.992
August	29.964	29.978	29.887	30.035	30.064	30.059	179.987	29.998
September ...	30.018	30.050	29.984	30.142	30.166	30.83	180.484	30.074
October	30.073	29.976	30.056	30.090	30.133	30.128	180.456	30.070
November ...	29.967	30.072	30.086	30.158	30.171	30.224	180.678	30.113
December....	30.038	30.074	30.094	30.118	30.230	30.186	180.740	30.123
Means........	30.024	29.985	29.997	30.947	30.104	30.125	180.282	30.047

A TABLE OF YEARLY MEANS AND RANGES OF BAROMETER AT CHAPEL HILL, N. C.

YEARS.	MEANS.	RANGE.
1854	30.024	1.12
1855	29.985	1.19
1856	29.977	1.20
1857	30.047	1.58
1858	30.106	1.24
1859	30.125	1.23

ALTERABILITY OF AMORPHOUS PHOSPHORUS.

J. C. ROBERTS.

Authorities are at varience as to the alterability of amorphous phosphorus. Fresenius says: (Qual. Anal.) "Red phosphorus does not alter in air." Miller, (vol. ii, p. 261), "The red phosphorus, if pure, absorbs oxygen slowly, the oxidation being more rapid if the powder is moist; phosphoric acid is formed and from its deliquescent character, the powder becomes damp. This oxidation occurs so slowly that it was at first imagined that the body underwent no change on exposure to air." Gmelin (vol. ii, p. 109,) says: "It is unalterable in the air." Fownes (ed'n 1878, p. 216,): "Nor has it any tendency to combine with the oxygen of the air." Roscoe & Schorlemmer (vol i, 479): "This substance can be exposed to air for years without undergoing any change. All commercial amorphous phosphorons, however, contains traces of the white modification and this undergoes oxidation in the air so that the mass always has an acid reaction owing to the formation of phosphoric and phosphorus acids." Watts (vol. vi, 934): "Groves found that amorphous phosphorus which had been kept for two years in a cracked vessel was converted to the extent of 16. p. c. into phosphorous and phosphoric acids."

So-called pure amorphous phosphorus, gotten from Marquart in Bonn, was left a year in a loosely stoppered bottle, then a portion of it transferred to a glass-stoppered bottle. At the end of another year it was noticed that the first lot was becoming pasty and deliquescent, a ¼ in. layer of a yellowish liquid covering the surface of the mass in the bottle. This was poured off and examined. It gave abundant tests for phosphoric acid reduced silver solutions and gave phosphine on heating so that it was seen to consist of phosphoric and phosphorous acids. A strong solution of phosphoric acid was then made and some dry amorphous phosphorus added to it. This gave reactions for phosphorous acid after standing over night and quite strongly on standing three or four days. Some of the phosphorus was then washed well with water and then alcohol. It was then washed with carbon bisulphide, this latter filtered off and washed away and the phosphorous gotten thus quite free from the yellow variety. When this was treated with a strong solution of phosphoric acid, it showed signs of oxidation but the dry powder exposed under a beaker and placed in a damp room was still dry at the end of three months.

"FALL OF BLOOD" IN CHATHAM COUNTY.

F. P. VENABLE.

A singular shower of some red liquid, supposed to be blood, which fell in Chatham on February 25th, 1884, was mentioned in some of the State papers, but little notice was taken of it. Nearly a week after the fall, Dr. Sidney Atwater brought a small specimen of sand soaked with this liquid to the University, to be examined. It was looked upon rather as a joke and no analysis was made for some time. When it was taken up several days afterwards there seemed to be sufficient interest attaching to it to warrant paying a visit to the locality where the matter fell. Meantime nearly three weeks had elapsed, and several heavy rains had fallen, so that when the place was reached (a small negro-cabin in New Hope township, about a quarter of a mile from the Raleigh and Pittsboro road) no vestiges of the matter could be found on the ground, and only one or two marks of drops on the fence. The woman who saw it fall was, however, examined and inquiries were made of the neighbors who visited the spot soon after. The fall came from a cloudless sky, when the wind was so slight as to be almost imperceptible.

The position of the drops seen on the fence indicated a very slight wind from the south or southwest, across some ploughed land. The woman was standing on this ploughed land, near a fence, along which some small pine bushes were growing She noticed something falling between her and the ground, saw it leave a red splash on the sand, heard a pattering like rain around her, looked up, but it was all over and she could see nothing. She was a good deal frightened and affected, taking it as a portent of death or evil of some kind. Mr. S. A. Holleman visited the spot the next morning, (the fall took place about mid-day), and has kindly given me the following facts observed: The space covered was about fifty by seventy feet, and nearly in a rectangular form. The drops were of sizes varying from that of a small pea to that of a man's finger and averaged about one to the square foot. Smaller drops were instantly absorbed, larger ones, with those on the wood, coagulated. Some fell in the bushes and coagulated upon the limbs. Dr. Robinson, living near, collected some of the freshly fallen material and made certain simple tests which satisfied him that it was blood. It even had the smell, he says, of fresh blood. Now as to the samples which I could procure for analysis: One from Mr. Holleman was gotten by some third person and consisted only of a few grains of stained sand. The other, also stained sand, was somewhat larger in quantity and came indirectly into the hands of Dr. Atwater, who gave it to me. It is a pity that a sample could not have been gotten more directly—one whose origin would have been placed beyond all dispute. The analysis is detailed at length, as it is important to see on what foundation rests the claims of this material to be blood. The sand placed in cold water gave a brown-red solution, which coagulated on heating. The coagulum, a dirty brown, was soluble in caustic alkalis, giving an indistinct green solution—treated with an acid solution of mercury nitrate, it gave a brick-red color. Nitric acid also caused the formation of this coagulum and gave the characteristic yellow tint on heating. The original solution in water was brightened in color, not turning green or crimson on adding ammonia. On leaving the solution two or three days, it readily putrefied, showing under the microscope a great swarm of bacteria Examined by the microscope, the appearance of small, slightly altered corpuscles was seen, corresponding well with those gotten from slaughter-yard soil. The spectrum of this substance when the solution was perfectly fresh gave a line in the yellow, none in the green, and a faint one in the red. On standing, the first two disappeared, and the red absorption band or line became very distinct; on adding ferrous sulphate the red line disappeared and the two first became distinct. To explain now: The yellow and green lines are characteristic of reduced hæmatine (the red coloring matter of the blood). The red line is characteristic of acid hæmatine. If you take fresh blood and add tartaric acid to it you get the red line—if you then add ferrous sulphate you get the yellow and green. The material then, according to the spectroscope, is partially decomposed blood. The test known as hæmin crystals could be gotten only indistinctly, if at all.

This leaves little or no reasonable doubt then that the samples examined had blood upon them. The question arises, were they carefully taken: had no animal ever bled on the same ground; had pigs never been slaughtered in that quarter of the field? etc. As to theories accounting for so singular a material falling from a cloudless sky, I have no plausible ones to offer. It may have been some bird of prey passing over, carrying a bleeding animal, but a good deal of blood must have fallen to cover so large a space. If a hoax has been perpetrated on the people of that neighborhood it has certainly been very cleverly done and an object seems lacking. On the possibility that it is not a joke, I have deemed this strange matter worthy of being placed on record. Other similar observations hereafter may corroborate it and combined observations may give rise to the proper explanation.

Chemical Laboratory, U. N. C.

NOTES ON THE PHENOMENA ACCOMPANYING THE TORNADO AND HAIL STORM, WHICH PASSED ACROSS CATAWBA AND IREDELL COUNTIES, N. C., MARCH 25TH, 1884.

J. A. D. STEPHENSON.

On the morning of the 25th nothing unusual could be observed about the weather. The sun rose clear at 7 a. m., temperature 50° with light wind from the south.

Very few clouds appeared before 12 o'clock noon; wind still light from the south. About 1 p. m., clouds commenced to form: at 2 p. m., temperature 78° and heavy clouds and thunder in the southwest; at 3 p. m., commenced raining with considerable wind from the southwest and lightning and thunder. This lasted about twenty minutes, and then cleared off. At 5 p. m., heavy clouds in the west and southwest, very black on the north side and copper colored towards the south side. The cloud advanced rapidly toward the east but was accompanied by no sound. It commenced raining at 5:30 p. m., still without any wind, but with lightning and heavy thunder and a fearful roaring. Hail commenced falling almost as soon as the rain. At first, hail stones very small, but they increased in size till the end of the storm. The hail stones were of a great variety of forms and size; the smaller ones were mostly of the shape of a small mush-room, with stem attached by which they could be held and examined, and were from one-half inch to one and a half inches in diameter. Most of the larger stones were of the following forms:

1st. Plane convex, circular, and three inches in diameter.

2d. Double concave, thin in the middle and three inches in diameter.

3d. Elliptical, solid, six inches in circumference on the longer diameter, and five inches on the shorter.

4th. Spherical, and roughened on the surface, presenting the appearance of a conglomeration of small cubes.

Others were flat and irregular in outline and covered with small spines of ice. Those of the first form or plane convex were opaque and the others of clear ice with a white opaque center or core. Many stones were reported larger than those the dimensions of which are here given, which are from actual measurement, but when the largest were falling it was dangerous to try to secure them.

Fortunately, there being no wind, the hail fell perpendicularly, and did but little damage.

Just before it stopped hailing, a dense fog commenced rising from the surface of the ground, and this continued for some time after the rain and hail was over. During the continuance of the storm it looked dark towards the north and light towards the south, producing the impression that the storm center had formed to the north, which was not the case. These developments were as follows: In a few minutes after the rain and hail ceased, reports were received that a cyclone had passed three miles south of Statesville prostrating everthing in its course.

Carefully collected facts and incidents from a number of intelligent persons living immediately in and very near its track, show that this tornado formed a few miles west of the town of Newton, in Catawba county, N. C., which town is distant twenty miles, nearly west from Statesville. Before reaching Newton it destroyed several houses and struck Newton on its southern limits, destroying twenty-five or thirty houses, some of them large buildings, such as churches and mills, injuring many more, and damaging fences, fruit trees, and timber. Continuing its course nearly east it destroyed almost everything in its track for an average width of one hundred and fifty feet. The full width of prostrated timber being nearly a quarter of a mile, but outside the width of one hundred and fifty feet the destruction was much less complete. The north side of the one hundred and fifty feet, was much more sharply defined than the south side, frequently on the north tearing off part of a house and leaving the rest slightly damaged. Crossing the Catawba river, near to and north of Buffalo shoals, it entered Iredell county, and continuing its general course and destructive work, it crossed the Atlantic, Tennessee and Ohio Railroad three miles south of the town of Statesville. At this point, it turned more to the north, crossing the Western North Carolina Railroad about two and a half miles east of the town. About one mile after it crossed the railroad it stopped in the valley of Fourth Creek, a small stream which runs nearly parallel with the railroad towards the northeast. This seems to be the end of this storm, but it is certain that a cloud had formed near Elmwood, a station on the W. N. C. Railroad, eight miles east of Statesville, and nearly five miles southeast of the point where the described storm stopped; and this second storm went in an east direction as far as the Yadkin River, and perhaps farther.

From evidence collected from persons along the track of the tornado after it crossed the Catawba River, it appears that it did not come in contact with the rain and hail storm until it reached the vicinity of Statesville, at which point it appeared to enter the track of the hail storm.

The general appearance of the tornado as described by persons who had the best opportunity of observing its approach, was that it resembled a mass of dark clouds boiling upwards from the surface of the earth, and some say assuming a funnel shape with a rapid rotary or whirling motion. Others describe it as resembling the smoke from a gigantic coal burning locomotive. It struck the bravest with terror by its terrible appearance.

Duration—At any fixed point from one to two minutes.

Precipitation—Most persons say none; a few say a little.

Noise—All accounts say the roaring of the storm would have drowned the loudest thunder in the vicinity of its track.

Contour of Ground—The ridges in the track of the storm present their more gentle slopes to the direction from which the tornado was approaching, the eastern faces being much more abrupt. On the western slopes the trees were blown down with their tops to the east, but on the more abrupt eastern slopes they were crushed to the ground lying in every direction, and splintered as if the force had been applied perpendicularly. Generally the greatest destruction was observed on the abrupt eastern slopes and in the hollows where ground was lowest.

Velocity—It has been very difficult to get the exact time the storm left Newton and passed the various points on the way, but from the best information at hand it left Newton at 5 o'clock p. m., and in the last dwelling destroyed where it crossed the W. N. C. Railroad, two miles and a half east of Statesville, a clock stopped at 5:43 p. m. Showing if these data are correct that its velocity was thirty and seven-tenths miles per hour.

Soon after the hail storm, I learned that many substances had been thrown outside of the track of the cyclone far to the north of it. On inquiry, I ascertained from more than one source of undoubted reliability, that many of the hail stones contained small quantities of clay and sand. The general course of the storm agrees exactly with that laid down as generally followed by similar storms in this latitude, by Prof. Elias Loomis, of Yale College.

Statesville, N. C., April 5th, 1884.

ACTION OF AMMONIA OF LEAD IODIDE.

J. L. BORDEN.

Lead iodide was prepared by precipitating pure lead nitrate with pure potassium iodide and thoroughly washing and drying the precipitate. In the first set of experiments three portions were taken. One was heated on the sand-bath ten hours, the second a similar time on the water-bath, the third was covered with ammonia solution and set aside for three days at a temperature of 15—20° c. In the first two instances no precautions were taken to keep a strong solution of ammonia over the iodide. In the analyes, lead alone was determined as pointing sufficiently accurately to the nature of the body formed. Corrections were made for the percentage of water retained in the powders analyzed. Generally two simultaneous lead determinations were made of each substance. The means of concordant analyses are given :

1. Substance heated on water-bath gave..............62.50 p. c. Pb.
2. Substance heated on sand-bath gave...............60.11 p. c. Pb.
3. Substance standing in the cold gave...............58.82 p. c. Pb.

Calculated for $PbI_2.PbO$ p. c. Pb=60.51. Calculated for $PbI_2.2PbO$ p. c. Pb.=68.45.

From this it would seem that the ammonia which was only moderately heated had the greatest effect ; that which was not heated at all had the least.

In the second set of experiments the heating lasted only seven hours (the mixture stood three days before heating) but care was taken to insure a strong solution of ammonia covering always the iodide. The results were as follows :

1. Substance heated on water-bath gave..............64.13 p. c. Pb.
2. Substance heated on sand-bath gave...............63.25 " "

Another set heated ten hours without previous standing were analyzed:

1. Substance heated on water-bath gave..............61.60 p. c. Pb.
2. Substance heated on sand-bath gave...............60.37 " "

From these results it is seen that the longer ammonia is allowed to act upon the iodide, the more iodine is removed, and hence the more oxide of lead formed. To test this, two portions were taken and the ammonia allowed to act on one for 38 hours (heating it on the water bath); on the second 68 hours. The analyses were as follows :

1. Substance heated 38 hours gave.....................74.10 p. c. Pb.
2. Substance heated 68 hours gave.....................78.94 " "

Calculated for $PbI_2.3PbO$ 73.26 p. c. Pb ; for $PbI_2.4PbO$ 76.38 p. c Pb. ; for $PbI_2.5PbO$ 79.31 p. c. Pb.

These experiments then would lead to the following conclusions:

1. By the action of ammonia in the cold the monobasic oxyiodide of lead is formed.

2. By heating the solution we get oxyiodides, the basicity of which is determined by the length of heating. If, by the more active boiling upon the sand-bath, the ammonia solution becomes weak, then the

tendency is to form the monobasic oxyiodide. The oxide of lead previously formed reacts upon the ammonium iodide, forming lead iodide and setting free ammonia.

In the case of the action of ammonia on lead chloride as examined by Mr. Wood (see this Journal), it seems that the oxychloride formed is not dependent upon the time of heating, but a definite oxychloride is formed whether heated six, ten or fifteen hours, provided the chloride is kept covered with an excess of ammonia. If by active boiling on the sand-bath the ammonia solution becomes too much weakened, then a definite oxychloride is formed, independent of the number of hours the solution is heated. Some of Mr. Wood's experiments were repeated to test these conclusions.

Chemical Laboratory, U. N. C., May, 1884.

DATES OF THE FLOWERING OF PLANTS:

COLLECTED BY REV. DR. JAMES PHILLIPS, K. P. BATTLE AND K. H. BATLTE.

PLANTS.	Day.	Month.	Year.
Acer rubrum, L. (Red Maple)	3	3	1853.
	1	4	1858.
Aeculus glabra, wild. (Ohio Buckeye)	10	4	1855.
Ailanthus glandulosus, Desf. (Tree of Heaven)	26	5	1853.
Amelanchier Canadensis, L. Shad-Bush)	20	3	1853.
Amygdalus nana (Flowering Almond)	20	3	1853.
Carya alba. Nutt. (Shellbark Hickory)	7	4	1853.
Cercis Canadensis, L. (Red-Bud. Judas Tree)	1	4	1851.
	30	3	1853.
	30	3	1858.
Chionanthis Virginica, L. (Fringe Tree)	20	4	1853.
Cornus Florida, L. (Flowering Dogwood)	19	4	1851.
	14	4	1853.
	12	4	1858.
Epigæa repeus, L. (Trailing Arbutus)	20	3	1855.
Erythronium Americanum, Smith. (Dog-tooth Violet)	21	3	1853.
	3	4	1858.
Fragaria Virginiana, Ehr. (Virginia Strawberry)	24	4	1853.
Geranium maculatum, L. (Cranesbill)	24	4	1853.
Houstania cœrulia, L. (Innocence, Bluets)	30	2	1853.
	19	4	1857.
Iris versicolor, L. (Large Blue Flag)	16	4	1853.
Kalmia latifolia, L. (Calico Bush. Ivey)	23	4	1851.
Liriodendron Tulipifera, L. (Poplar, Tulip Tree)	25	4	1858.
Morus rubra, L. (Red Mulberry)	28	4	1853.

Plants.	Day.	Month.	Year.
Prunus Persica (Peach)	27	2	1851.
	18	2	1883.
	15	4	1858.
Pirus malus (Apple)	29	3	1853.
	21	4	1858.
Quercus alba., L. (White Oak)	4	4	1853.
Rhododendron Catawbiense, Michx. (Laurel)	20	4	1858.
Rhododendron nudiflora, Torr. (Azalia. False Honeysuckle)	12	4	1857.
	17	4	1853.
Robinia Pseudacacea, L. (Common Locust)	22	4	1857.
Robinia Viscosa, Vent. (Claming Locust)	25	4	1858.
Rubus Villosus, Ait. (Blackberry)	18	4	1853.
	28	4	1858.
Sambucus Canadensis, L. (Common Elder)	1	6	1853.
Sanguinaria Canadensis, L. (Blood Root)	20	3	1853.
	30	3	1858.
Sassafras officinale, Nees. (Sassafras)	20	3	1855.
Syringa ulgaris. (Lilac)	1	4	1853.
	7	4	1852.
Taraxacum Dens-leouis, Desf. (Dandelion)	7	2	1853.
	3	4	1854.
	7	4	1858.
Vitis æstivalis, Michx. (Summer Grape)	14	5	1853.

DATES OF THE FOLIATION OF PLANTS;

Collected near Chapel Hill, N. C., by the Rev. Dr. James Phillips. K. P. Battle and R. H. Battle.

Plants.	Day.	Month.	Year.
Acer dasycarpum, Ehrh. (Silver Maple)	30	3	1858.
Acer rubrum, L. (Red Maple)	2	4	1853.
Achillea millefolium, L. (Yarrow, Milfoil)	23	3	1853.
Ailanthus glandulosus, (Desf. (Tree of Heaven)	20	4	1853.
	8	4	1858.
Amelanchier Canadensis, L. (Shad-bush)	18	4	1853.
Amygdalis nana. (Flowering Almond)	23	3	1853.
Asclepius cornuti, Decaisne (Milk Weed)	7	5	1853.
Carya Alba, Nutt. Shell-bark Hickory)	3	4	1858.
Cercis Canadensis, L. (Red-Bud, Judas Tree)	20	4	1853.
	30	4	1858.
	16	4	1859.
Chionanthus Virginica, L. (Fringe Tree)	20	4	1553.
	15	4	1858.
Cornus Florida, L. (Flowering Dogwood)	18	4	1853.
	5	4	1858.

PLANTS.	Day.	Month.	Year.
Cratægus Crus-galli, (Cockspur Thorn)	29	3	1858.
Cratægus Oxycanthus, L. (English Hawthorn)	7	4	1858.
Erythronium Americanum, Smith. (Dog-tooth Violet)	20	3	1853.
Fragaria Virginiana, Ehrh. (Virginia Strawberry)	1	4	1853.
Fraximus Americana, L. (White Ashe)	9	4	1858.
Houstonia Caærulea, L. (Bluts, Innocence)	15	2	1853.
Iris versicolor, L. (Large Blue Flag)	12	4	1853.
Benzoin odoriferum, Nees. (Spice Bush)	20	4	1853.
Liriodendron Tulipifera, L. (Tulip Tree. Poplar)	28	3	1853.
	19	3	1858.
Morus rubra, L. (Red Mulberry)	25	4	1854.
	6	4	1858.
Platanus occidentalis, L. (Sycamore)	10	4	1853.
Pirus communis, (Pear)	11	3	1853.
	7	3	1858.
Pirus malus, (Apple)	28	3	1853.
	25	3	1858.
Quercus alba, L. (White Oak)	12	3	1853.
	9	3	1858.
Rhododendron nudiflorum, Torr. (Azalea. False Honeysuckle)	20	4	1853.
Robinia Pseudacacea, L. Common Locust)	24	4	1853.
Rosa rubiginosa, L. (Sweet Brier. Eglantine)	1	4	1153.
Rubus villosus, Ait. (Blackberry)	26	3	1853.
	1	4	1858.
Sambucus canadensis L. (Common Elder)	11	3	1853.
Sanginaria candensis, L. (Blood Root	20	3	1853.
	30	3	1858.
Sassafras officinale, Nees. (Sassafras)	17	4	1853.
Syringa Vulgaris (Lilac)	23	3	1853.
	28	3	1858.
Taraxacum Dens-leonis, Desf. (Dandelion)	1	4	1853.
Ulmus Americana L. (American Elm)	1	4	1853.
	3	4	1858.
Viburnum Opulus (Snowball)	10	5	1853.

ZINC IN DRINKING WATER.

The increase in the use of galvanized iron, especially in the form of water tanks and pipes, has lead to a reopening of the question as to the possible injurious effects from the use of such water. It is a matter of importance then to us how far our knowledge extends on this subject, and I will collect here all of the known facts so far as I have been able to get at them.

The so-called galvanized iron is of course nothing more than iron dipped in a bath of zinc and so superficially coated with it and to a certain extent alloyed with it. The character of the protection afforded the iron is galvanic (hence the name), the two metals forming a galvanic couple, so that under the action of any exciting liquid, the zinc and not the iron is attached. That zinc dissolves in potable waters has long since been shown by the experiments of Boutigny, Schaueffele and Langonne. Distilled water and rain water dissolve it more readily than hard water. Especially is water containing carbonic acid capable of this solvent action. So much may be taken up that the water becomes opalescent and acquires a distinctly metallic taste. It seems that by the action of water, hydrate and carbonate of zinc are gradually formed, and that this action is more rapid in the presence of certain saline matters, but is weakened by the presence of calcium salts.

As to the injurious effect of such waters, authorities differ. Fonssagrives has investigated the question, consulting the statistics of the French Navy and the recorded experiments of other, adding, however, none of his own. The French Government had, before this, appointed a committee to make a special report on the subject, and the investigations of Roux in 1865 and 1866, furnished evidence enough of possible injury to health from water stored in galvanized iron tanks to lead to an order, from the Minister of Marine, prohibiting the use of such tanks on board of ships of war. Boutigny attributed grave effects to the use of these zinc-containing waters, looking upon it as probably resulting in epilepsy. Fonssagrives, however, maintains that the zinc is not cumulative and produces no bad effects unless taken in large doses. Doubt is thrown on this position though by the fact that his assertions as to the limited solubility of zinc in ordinary drinking water are not sustained by experiments. Without doubt such waters have been used for considerable lengths of time and no injurious effects have been noticed. This may have been due, however, to the hardness of the water, and hence the small amount of zinc dissolved. Pappenheim states in contradiction to the assertion of Fonssagrives that zinc vessels are dangerous and must be carefully avoided. Dr. Osborne, of Bitterne, has frequently observed injurious effects from the use of waters impregnated with zinc. Dr. Stevenson has noticed the solvent action of rain-water on galvanized iron and states that probably its continued use would cause injury to health. He recommends as a convenient test for the presence of zinc in potable waters, the addition of potassium forocyanide to the filtered and acidulated water. Zinc gives a faint white cloud or a heavier precipitate when more is present. Dr. Frankland mentions a case of zinc poisoning where well-water, containing much dissolved oxygen and but little carbonic acid, was used after passing through galvanized iron pipes. Prof. Heaton has recorded the analysis of a spring water in Wales, and a second analysis of the same water after passing through half a mile of galvanized iron pipe, showing that the water had taken up 6.41 grains of zinc carbonate per gallon.

A similar instance of zinc impregnated water has come under my own observation, and I append the analytical results. The water from a spring 200 yards distant was brought by galvanized iron pipes to a dwelling house and there stored in a zinc lined tank which was painted with white lead. The water became somewhat turbid and metallic-tasting and its use for drinking purposes was discontinued. Analyses were made after the pipes had been in use about one year. A somewhat full analysis of the spring water was made under my direction by Mr. J. C. Roberts. The analyses of water from the tank and directly from the pipe, I carried out only so far as zinc, iron, and tests for lead were concerned. The results are calculated in grains per gallon of 231 cu. in.:

ANALYSIS OF SPRING.

Silica	2.45	grains.
Lime	.23	"
Magnesia	.17	"
Alkalies	.43	"
Chlorine	.35	"
Sulphuric acid	.19	"
Carbon dioxide (calculated)	.45	
Total residue on evaporation	4.34	

The tank contained 4.48 grains of zinc carbonate per gallon with a trace of iron and no lead. Water from the pipe gave 4.29 grains of zinc carbonate per gallon and a trace of iron.

It is evident then, when the dangerous nature of zinc as a poison is taken into consideration, that the use of zinc-coated vessels in connection with water or any food-liquid should be avoided.

AN ATTEMPT AT FORMING COPPER AND BARIUM ACETATE.

J. C. ROBERTS.

The double acetate of copper and calcium is described in Watts' Dictionary (I, 15), but no mention is made of a corresponding double acetate with barium. The preparation of this body was undertaken as an exercise in manipulation and an account of the experiments is here given as showing some of the difficulties which prevented its formation.

Pure, crystallized copper acetate was prepared and also a supply of pure barium acetate. A mixture of the concentrated solutions of these salts with an excess of barium acetate was evaporated on a water-bath to thick syrupy consistence, giving a deep blue liquid, from which after four days' evaporating a mass of crystals settled out. These crystals seemed blue but on thorough washing with alcohol proved to be barium acetate.

The two salts in concentrated solution were then mixed in the proportion of their molecular weights. One portion was still further concentrated by evaporation on a water-bath and then exposed in a crystallizing dish to a temperature of 20°—25° c. The other was placed under a glass receiver over sulphuric acid. Green crystals formed in both of these dishes, alternating with the settling out of flocculent masses of some bluish substance. These masses had a silky, crystalline appearance. All green crystals were removed, the blue mass washed and copper and barium determinations made. A little acetic acid was generally added to effect complete solution before analysis. The barium in three different samples ranged from 3.90 to 4.10 per cent., but seemed an accidental impurity from insufficient washing. The copper in two determinations gave 48.82 and 45.85 per cent. The amounts procurable for analysis were however very small. The mass seemed to be then a basic acetate. It was found that the production of this blue settling out could be greatly hastened by adding alcohol to the mixed solutions and allowing the dish to stand in a free current of air at about 20° c. Two specimens gotten in this way were analysed giving copper=35.47 per cent.; barium = .90per cent., and from the second copper=34.25

per cent.; barium=1.12 per cent. The percentage of copper in the normal acetate is 34.49.

According to Watts the acetate of copper and calcium is prepared by simple evaporation at 25°—27° c. of the mixed (in molecular proportions) solutions of the two salts. It would seem from these experiments that the barium double acetate cannot be gotten in the same way. The tendency to form a double salt of copper and barium is not so great as in the case of copper and calcium. Time was lacking for a further examination of the subject.

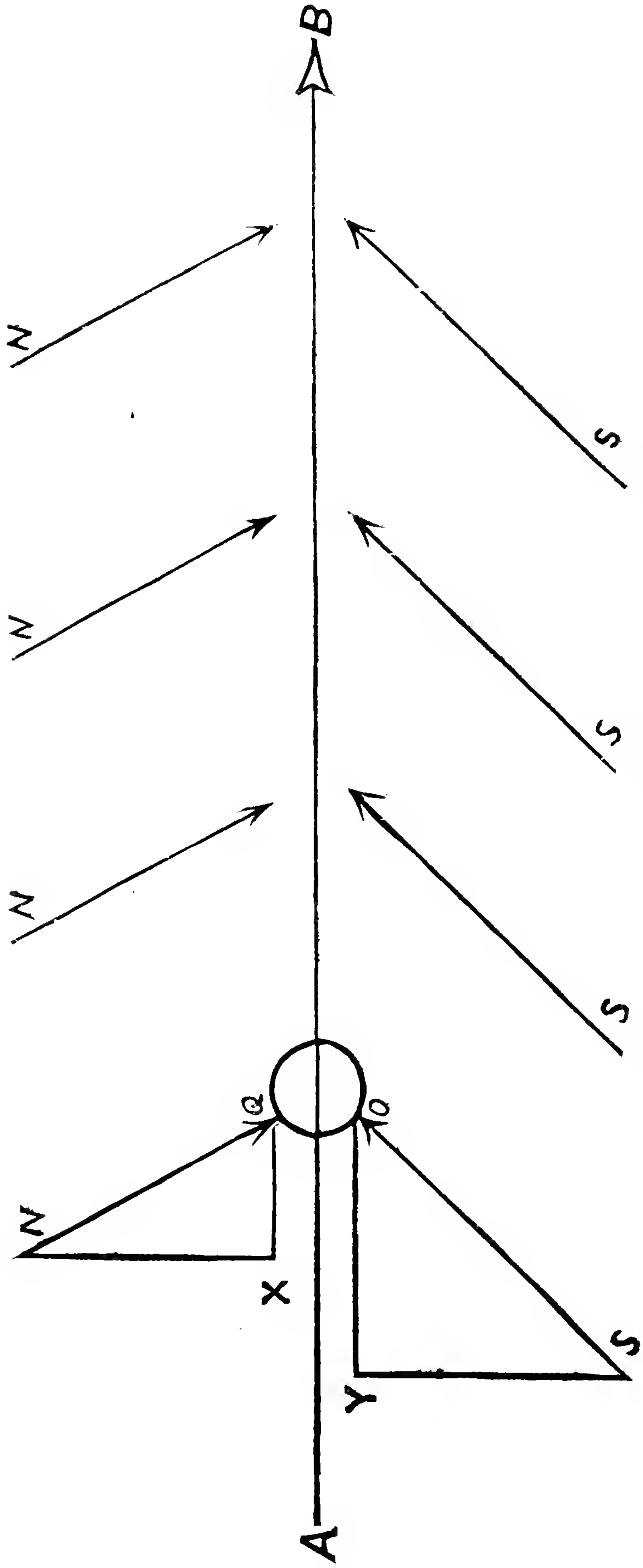
Chemical Laboratory U. N. C., May, 1884.

A THEORY OF TORNADOES.

J. W. GORE.

Tornadoes are phenomena accompanying a great disturbance of the atmospheric equilibrium. A centre of minimum pressure travels across the continent, say in a northeast direction, and any where south and east of its track tornadoes may occur. This centre of low pressure produces and tends to produce a cyclonic movement of the air over a large area of country. The wind to the south and east will be southwest, warm and moist. Suppose a given area to be within the region of the cyclonic currents, which are from the north and west and therefore cold and dry. The meeting of these winds of different temperatures and hygrometric states will cause condensation, liberation of heat and a consequent fall of the barometer. Thus a cloud will be formed, gradually extending southward, for simplicity we will suppose this cloud to be bounded on the south by an east and west line. Along this line the air is rarified, thereby accelerating the southwest wind and causing the air on the north side to move towards this line, the slowl moving cyclonic current giving an eastern component of motion; hence it will be a wind west of north. The condensation of moisture will thus be increased by the accelerating and producing of these winds, and in their turn these velocities will be augmented until they attain considerable violence.

Suppose A B (in the fig.) to be the line of the southern edge of the cloud formation and the line along which the wind S, S, S, &c., from the southwest meet the wind N, N, &c., from the north and west.



Let S O and N Q represent these winds in magnitude and direction. S Q is necessarily greater than N Q.

The effect of these winds upon the air at the place of meeting will be best determined by resolving them in directions perpendicular and parallel to A B. N X and S Y will be the components perpendicular to A B, and X Q and Y O those parallel. If N X is equal to S Y the air at (O Q) will not be urged out of the line A B, and also Y O will be greater than X Q ; hence the air at (O Q) will be made to rotate opposite the hands of a watch. A rotating mass of air may be regarded as an isolated mass and capable of being acted on by the pressure of wind, especially as these forces tend to preserve and accelerate this motion.

Hence the components N X and S Y being equal and opposite neutralize each other, leaving X Q and Y O as the effective components, which because they are unequal in magnitude produce rotation and because they act in same direction A B produce translation.

As long as the components N X and S Y are equal, the rotating mass of air is driven forwards in the line A B and is constantly acted on by these forces S, S, &c., and N, N, &c., which may be similarly resolved, the components in direction of A B will be forces continuously acting, accelerating the velocities of rotation and translation. The maximum of each motion is reached when the accelerating force is equal to the resistance to motion by friction, &c.

The action necessarily begins along the southern edge of the cloud, and the whirl may reach the surface of the earth both by friction against the air underneath and by the winds producing it extending down to the earth.

The tornado cloud is formed by the cooling of the air in the centre of the rotating mass, which is the result of diminished pressure, owing to the so-called centrifugal force.

The upward rush of air along the axis of rotation is also due to diminished pressure along that line.

Electric phenomena would seem to be results and not agents.

The greater extent of destruction on the south side of centre of tornado track is also accounted for, since the supposition requires that the wind on south side shall have a greater velocity than that on north side and is able to prostrate trees, &c., before it begins to whirl.

University N C., May 3d, 1884.

SOLUBILITY OF NORTH CAROLINA PHOSPHATE ROCK.

J. L. BORDEN.

In the American Chemical Journal (v. 6, p. 3), Gladding records certain experiments on the amounts of various natural phosphates dissolved by ammonium citrate solution under different conditions. With a view to comparing the newly found North Carolina phosphates with these a corresponding series of experiments were carried out with some specimens in the possession of the University. The conditions of the experiments were the same as is in the paper mentioned above. One gram of phosphate was used and ammonium citrate solution of the specific gravity 1.09. 50 c.c. of this was taken, a closely stoppered flask was used and the digestion lasted 30 minutes.

1st, One gram with neutral solution at 40° c.
2d, One gram with neutral solution at 65° c.
3d, One gram with ammoniacal solution at 65° c.
4th, One gram with acid solution at 65° c.

The specimens taken were:

1st, A light colored sandy friable phosphate from North Carolina.

2d, A light colored sandy friable phosphate from South Carolina (land rock.)

3d, A compact hard grey friable phosphate from North Carolina.

4th, South Carolina river rock (Gladding's results quoted).

No. of Specimen.	Dissolved by 1st solution.	Dissolved by 2d solution.	Dissolved by 3d solution.	Dissolved by 4th solution.	Total per ct. present.
1	2.95	3.21	1.00	4.61	21.37
2	1.61	2.83	.46	7.69	28.48
3	1.00	1.07	----	2.48	20.64
4	1.09	1.35	1.06	2.89	----

The analyses were carried out in the ordinary way (precipitation with ammonium molybdate and then with magnesia mixture, &c.). The results are given in percentages of P_2O_5.

Chemical Laboratory U. N. C., May, 1884.

COTTON-SEED ANALYSES.

E. A. DESCHWEINITZ.

The interest attaching to the variation in the percentage of fats yielded by different varieties of cotton-seed, has led to the analysis of several American and foreign seeds, with results as tabulated.

Table I gives a food stuff analysis of the kernel, and table II the value of the raw seed as to its ash, and possible yield of fats.

In all cases the fats were extracted with ether, the proteins calculated from the percentage of water, the fat-free residue was washed with NaHO and H_2SO_4 to find the crude cellulose and the carbohydrates obtained by difference. The calculations are all made on the air-dried seed. Eight varieties in all were examined.

No. 1. Belongs to the botanical species Gossypiun hirsutum; generally supposed to be a variety of the Gossypimn Barbadense. It is called the "Duncan" cotton, comes from the eastern part of the State, was grown on sandy land with a yield of 400 pounds to the acre.

No. 2. Also Gossypiun hirsutum, known as the "Heavy Boll Prolific," was grown on sandy loam in the central part of the State with a yield of 300 pounds to the acre.

No. 3. Gossypimn hirsutum, known as "Sea Island" cotton, grown for one year on clayey loam in the central part of the State with a fair yield.

No. 4. Is known as the "Hodge" cotton, was grown on sandy upland with a yield of between 300 and 400 pounds to the acre.

No 5. Known as the "American Cotton Tree," is a variety not cultivated for commercial purposes but grows wild on marsh land in warm districts. The seed shows a noticeably high percentage of ash and fats. The tree being fairly large probably concentrates a large amount of mineral matter in the seed for its use in germinating.

No. 6. Gossypium Barbadense, is an Egyptian cotton.

No. 7. Belonging to the same variety is from the West Indies: and

No. 8, is from the "Red Cotton" of Southern Russia. These last seeds were small, of a gray color and had a slightly musty odor, showing that they had probably undergone a slight change. This may account for the very high percentage of fats.

Experiments in selecting seed and cultivation with a view to increasing the yield of fats and the nutritive ratio would be interesting and valuable. As the use of a dominant ingredient, potash, in the fertilizer is found to increase the percentage of sugar in the beetroot, so the use of a special fertilizer on the cotton might be made to increase the value of seed as well as of the fibre. As soil and climate affect the quality and yield of the cotton, so is the seed influenced. The same variety consequently shows variations in different seasons and localities and even in the same field.

I. KERNEL.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	No. 8.
Moisture @ 212° F.	7.08	7.25	7.50	7.23	6.45	8.81	7.46	6.94
Ash	4.91	4.15	3.51	4.23	5.41	4.96	4.45	4.92
Fats	34.42	40.39	39.76	38.09	44.70	38.54	36.77	32.71
Crude Cellulose	4.70	3.43	4.24	4.21	4.06	4.33	5.12	5.00
Protein Nitro. Matter	30.25	27.94	23.44	27.68	21.62	27.25	28.81	35.18
Carbohydrates N. free Extract	13.64	16.84	21.55	18.56	17.76	16.11	17.29	15.25
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Nitrogen	4.84	4.47	3.75	4.43	3.46	4.38	4.61	5.63
Equiv. to NH_3	5.87	5.42	4.55	5.38	4.20	5.29	5.59	6.81
Nutritive Ratio	1:1.90	1:2.17	1:2.80	1:2.19	1:3.07	1:2.13	1:2.05	1:1.50
II. Whole Seed—Kernel, Hull.								
Ash	4.26	3.46	3.26	3.40	4.27	3.62	3.47	4.12
Fats	19.71	20.19	19.88	19.04	22.35	19.27	18.38	16.35

RATE OF REVERSION IN SUPERPHOSPHATES PREPARED FROM RED NAVASSA ROCK.

W. B. PHILLIPS.

(Abstract from Part of Thesis for Ph. D.)

The manufacture of a high grade superphosphate from Red Navassa Rock is one of those problems which, appearing easy of answer, yet present great difficulties. How great these difficulties are, only the manufacturer knows. Working formulæ which on other natural phosphates give entire satisfaction, on Red Navassa give curious and rather discouraging results. In this Rock we have to deal with a mixture of the phosphates of Calcium, Iron, and Aluminum, and the oxides of Iron, and Aluminum. The superphosphate made from it is consequently of a more complicated structure than that made almost entirely of Tri-calcium Phosphate, i. e., from bone, or Apatite, or Charleston Rock. In a high grade superphosphate made from Red Navassa Rock, the Soluble Phosphoric acid exists in a more easily decomposable form than it does in any other superphosphate with which I am acquainted. It is reverted instantly on diluting the aqueous solution. The same is true, to a limited extent, of similar articles made from Charleston Rock.

In the superphosphate itself, the rapidity with which reversion takes place is largely dependent upon the content of Iron and Aluminum. In most cases, if all the phosphoric acid has been rendered soluble, the reversion proceeds slowly. But if any unattacked Iron and Aluminum oxides are present, the reversion proceeds rapidly. (Compare H. Joulie, Compt. Rendus 88, 1879, p. 1324, and Carl Ferd. Meyer, Zeit. An. Chem. 1880, p. 309.)

I have recorded in the following tables the results of some observations made on Superphosphates prepared from Red Navassa Rock. The material used was of uniform fineness, the whole of it passing through a 60 mesh sieve. The samples were prepared so that in one there should be about 5 per cent., in another about 8 per cent., and in the third about 14 per cent. soluble phosphoric acid.

The same method of analysis was used in every case. All the phos. acid determinations were made with Ammon. Molyb. For the estimation of insol phos. acid there was used a slightly alkaline solution of Ammon. Citrate, 100 c. c. to 2. Gms. time 30 mins. Some of the comparative determinations of insol. phos. acid had to be omitted from lack of time, but it is hoped that those that appear will prove to be sufficient for the end in view. The reverted phos. acid was determined by difference.

TABLE I.

Calculated on a dry basis.	3d day after Mixing.	10th day after Mixing.	17th day after Mixing.	4th wk. after Mixing.
	Per cent.	Per cent.	Per cent.	Per cent.
Total Phos. Acid....	19.42	19.42	19.42	19.42
Soluble " "	4.68	4.08	4.65	3.36
Insol. " " 40°	7.04	4.46	3.59	5.97
" " " 60°	4.15	3.48	3.50	5.03
" " " 100°	1.96	3.81	2.86	-----
Reverted " " 40°	7.70	10 88	11.18	10.09
" " " 60°	10.59	11.86	11.27	11.03
" " " 100°	12.78	11.53	11.91	-----
Available " " 40°	12.38	14.96	15.83	13.45
" " " 60°	15.27	15.94	15.92	14.39
" " " 100°	17.46	15.61	16.56	-----
Moisture	32.85	29.63	24.07	21.50

TABLE II.

Calculated on dry basis.	At Mixing.	End of 3d week.	End of 4th week	End of 5th week	End of 6th week	End of 7th week	End of 8th week	End of 9th week	End of 10th w'k.	End of 11th w'k.	End of 12th w'k.	End of 13th w'k.	End of 14th w'k.
	p. c.	p. c.	p. c.	p. c.	p. c.	p. c.	p. c.	p. c.	p. c.	p. c.	p. c.	p. c.	p. c.
Total Phos. Acid...	21.77	21.77	21.77	21.77	21.77	21.77	21.77	21.77	21.77	21.77	21.77	21.77	21.77
Sol. " "	7.83	6.16	5.40	5.10	5.02	4.17	3.79	3.49	3.10	3.17	3.09	3.04	3.25
Insol. " " 60°	8.46	8.72	9.06	8.71	8.58	8.05	7.24	7.86	8.09	8.18	7.63	7.32	7.66
" " " 100°	....	8.76	8.97	8.34	8.03	7.99	7.34	7.82	7.83	7.57	7.68	7.24	7.60
Rev'd " " 60°	5.48	6.89	7.31	7.96	8.17	9.55	10.74	10.42	10.58	10.42	11.05	11.41	10.86
" " " 100°	....	6.84	7.40	8.53	8.72	9.61	10.64	10.46	10.84	11.03	11.00	11.49	10.91
Avail. " " 60°	13.31	13.05	12.71	13.06	13.19	13.72	14.53	13.91	13.68	13.59	14.14	14.45	14.11
" " " 100°	....	13.00	12.80	13.43	13.74	13.78	14.43	13.95	13.94	14.20	14.09	14.53	14.17
Moisture	31.49	26.16	30.77	16.14	12.41	8.22	6.01	5.17	5.22	6.86	6.03	5.36	6.10

TABLE III.

CALCULATED ON A DRY BASIS.	At Mixing.	End of 1st wk.	End of 2d wk.	End of 3rd wk.	End of 4th wk.
	p. c.	p. c.	p. c.	p. c.	p. c.
Total Phosphoric acid	20.17	20.17	20.17	20.18	20.17
Soluble Phosphoric acid	14.02	15.42	12.57	12.20	11.60
Insoluble Phosphoric acid 40°	1.28	.94	.94	.32	.42
" " " 60°	------	.77	.76	.42	------
" " " 100°	------	.63	.39	.41	------
Reverted Phosphoric acid 40°	4.87	5.81	6.66	7.65	8.15
" " " 60°	------	5.98	6.84	7.55	------
" " " 100°	------	6.12	7.21	7.56	------
Available Phosphoric acid 40°	18.79	19.23	19.24	19.85	19.75
" " " 60°	------	19.40	19.41	19,75	------
" " " 100°	------	19.54	19.78	19.76	------
Moisture	41.61	30.20	30.19	29.29	28.90

The sample yielding about 8 per cent. sol. phos. acid was examined through a much longer time than either of the others. For comparison, therefore, we must consider them at the end of the same time, i. e., at the end of the 4th week. During this time, as indeed throughout the experiment, the samples worked on stood in large earthenware pans in the Laboratory and were protected from dust.

Table IV shows the rate of reversion for 4 weeks, absolute and comparative, and the accompanying loss of moisture:

TABLE IV.

	At Mixing.	4 weeks after mixing.	Loss of Soluble.	Reverted p.c. of original Soluble.	Loss of moisture in 4 weeks.	Loss of moisture p. c. of original.
	p. c.	p. c.	p. c.	p. c.	p. c.	p. c.
Soluble Phosphoric acid..........	4.68	3.36	1 32	28.21	11.35	34.55
" " "	7.83	5.40	2.43	31.03	10.72	34.05
" " "	14.02	11.60	2.42	17. 26	12.75	30.61

TABLE V—COMPARE TABLE II.

Behaviour of Insol. Phos. Acid.

+ denotes gain					— denotes loss.			End of weeks.			
3	4	5	6	7	8	9	10	11—	12	13	14
+ p.c. .26	+ p.c. .60	+ p.c. .25	+ p.c. . .2	— p.c. .41	— p.c. 1.22	— p.c. .60	— p.c. .37	— p.c. .28	— p.c. .83	— p.c. 1.14	— p.c. .80

TABLE VI—COMPARE TABLE II.

Behaviour of Soluble and Reverted Phos. Acid, 60°.

	3d week.	4th Week.	5th week.	6th week.	7th week.	8th week.	9th week.	10th week.	11th week.	12th week.	13th week.	14th week.
	p. c.	p. c.	p. c.	p. c.	p. c.	p. c.	p. c.	p. c.	p. c.	p. c.	p. c.	p. c.
Loss of Phos. acid	1.67	2.43	2.73	2.81	3.66	4.04	4.34	4.73	4.66	4.74	4.79	4.58
Gain Rev'td "	1.41	1.83	2.48	2.69	4 07	5.26	4.94	5.10	4.91	5.57	5.93	5.38

The most striking fact brought out by these tables is that the Insol. Phos. acid is not stationary, but oscillates from week to week. Thus from Table V it is seen that this oscillation of Insol. Phos. acid is from a gain of .60 per cent. to a loss 1.22 per cent., the interval between being four weeks.

The oscillation of Insol. Phos. acid has been touched upon by J. Post, (Chem. Industr. 1882, p. 217), who states, among other most interesting facts, this, that during the first month the phosphates which have become insoluble in water remain soluble in citrate at 40°; but later on a part of the Reverted Phos. acid insoluble at 40°

becomes insoluble in citrate even at 90°. In other words, the per cent. of Insol. Phos. acid varies from time to time. In reflecting upon this subject, there was reason to suspect that this variation was largely controlled by the mechanical condition of the analytical sample. Some experiments were begun on this point, but could not be carried through, owing to the pressure of routine work. In passing an article of 6 per cent. or 8 per cent. moisture through a 40 mesh seive, a good deal of it must necessarily be pulverized finer than the seive. The less moisture the article holds, other things being equal, the more will there be of it much finer than the seive. The citrate acts upon this fine stuff more effectually than upon the coarser, and in this way the variation of the Insol. Phos. acid may be partially explained. Doubtless this has some effect, for from the 7th through the 14th week, Tables II and V, when the moisture varied from 8.22 per cent. to 5.17 per cent., there was a loss of insol. phos. acid all the time.

Other interesting points might well be considered did this space allow. Such as they are the careful reader will recognize. It is hoped to follow up this discussion with some parallel observations as soon as possible.

Laboratory of the Navassa Guano Company,
Wilmington, N. C.

NORTH CAROLINA PHOSPHATES.

W. B. PHILLIPS.

(Abstract from Thesis for Ph. D.)

So much has been said and written about North Carolina Phosphates during the last six months, that it appears necessary now only to give an abstract of the first detailed investigation of the subject, together with such additional information as has been acquired by the writer up to this time.

It can hardly be said that the true Phosphate Rock (of value to be worked without concentration) had been noticed in North Carolina, prior to August, 1883. Coprolites more or less rich had indeed been found and in more or less advantageous localities. But the supply of these was wholly insufficient for the demands of a moderate size factory even. Some hand specimens of very good phosphate had been examined, and endeavors made to find the deposit from which these were said to have come. The hand specimens and the analyses were good enough, but the deposit—well the deposit has not been found yet. Some fairly good hand specimens from Duplin county had been examined before the investigation into the subject began, but they were regarded perhaps as from some pocket of coprolites, and hence as of no great importance.

It was not until August, 1883, that the matter assumed sufficient importance to demand careful recognition. On the 10th of that month in the *Morning Star* of Wilmington, N. C., appeared a letter from Major W. L. Young, Chief Engineer of the Duplin Canal Company, in which he gave an account of what he took to be Phosphate Rock in Duplin county. This was the first public intimation of the discovery of the true Phosphate Rock in North Carolina. Major Young considered it Phosphate, and my examination of about 75 pounds of it confirmed his judgment. The Rock he brought to me had been selected with care, for it fell readily into 3 (three) varieties, which varieties I afterwards fully verified from several tons.

1° A hard, heavy, block, fine grained sub-crystalline Rock, most frequently water-worn, and generally perforated to the depth of ½ inch to 1 inch with cylindrical holes of a diameter from ¼ to ½ inch. These perforations are generally, though not always, filled, and the filling material is sand and mud. It is the richest in Phosphoric acid of all the varieties. On concussion it has a slight Phosphatic odor.

2°. A hard, heavy, fine grained sub-crystalline Rock, with whitish and somewhat softer exterior, a black, hard core, and not so distinctly water worn as No. 1. This core generally comprises four-fifths of the mass of the Rock, and probably nine-tenths of its weight. Similar perforations occur in this variety filled with the same material, but they do not extend into the black core. It is likely that this variety is a modification of No. 1. It contains less Phosphoric acid than No. 1, and has on concussion a decided but not strong Phosphatic odor.

3.° A light to dark grey Rock, neither as heavy, nor as hard, nor as distinctly marked as the two former varieties, nor as good. The time at my disposal did not allow me to make complete analyses of these varieties. But No. 1 is composed of about equal parts of sand and tri-calcium phosphate, with some calcium carbonate, and small quantites of Iron and Aluminum. Quantitative estimations were made of sand, and phosphoric acid, as the samples were very dry.

	Number of Analyses.	Average Phosphoric acid.	Average Tri-Calcium Phosphate.	Average Sand.
		per cent.	per cent.	per cent.
Variety 1	9	19.36	42.13	42.64
" 2	8	17.42	38.52	51.31
" 3	1	12.79	37.92	64.70

An analysis of the white shell marl (Miocene ?) occurring above variety at W. H. Kornegay's gave me, air dried

	Per cent.
Calcium Carbonate	41.84
Sand	20.15
Phosphoric acid	.50

On the 27th day of August, I visited Duplin county in company with Major Young, and began an investigation into the Phosphate Rock. This was the first attempt at any thing like a systematic consideration of the subject, and although from the very nature of the case it could not be as full as was desired, still every fact herein stated about the Rock is the result of careful personal experience. The beds I visited are located in the western part of the county of Duplin, North Carolina, 50 miles north of Wilmington, and from 2½ to 7 miles east of the line of the Wilmington and Weldon Railroad. The places visited were the farms of W. H. Kornegay, Geo. McClammy, Halstead Bowden, Alonso Middleton and David Chestnut, all within 4 miles, a little N. of E. of Magnolia, a station on the W. & W. Ry., 48 miles N. of Wilmington. Arminius Johnson, 5½ miles, John W. Murray, 8 miles, a little N. of E. of Magnolia. A similar Rock occurs also in Kenansville, 7 miles N. of E. of Magnolia. All these places are located a little east of the divide between the Cape Fear and the North East Rivers, but much nearer the latter, from which they are distant from 4 to 8 miles west. The beds so explored appear to occupy the bottoms of former streams or lagoons, whose positions are now occupied by "branches," "runs," and ditches, emptying their waters into the North East River, or one of its numerous tributaries. The configuration of the surface of the county is that of a broad, flattish plateau, intersected by creeks, branches, "runs," and swamps. Its elevation above sea level is from 50 to 125 feet. From the line of the W. & W. Ry., which traverses the county from N. to S. in its western part, it slopes E. and W. with a general tendency towards the east, so that most of the streams empty into the North East River.

On nearly every little stream and creek between Maxwell Swamp and the North East River, 11 miles the Rock can either be seen or exposed with very little trouble. Its average depth below the surface is from 3 to 5 feet with clay, sand and soil above. At one pit I found as follows :

	Feet.	Inches.
Cultivated soil and earth	1	0
White sandy clay	0	6
Light-yellowish-red clay	1	0
Mottled white and red clay	4	6
Phosphate in its sand and gravel	0	10
	7	10

The Phosphate Rock is imbedded in a coarse, whitish sand, mixed with water worn quartz pebbles, and minute garnets.

ABSTRACT OF CONCLUSIONS.

(a). The Rock is to be found in the ditches, dry "runs," and branches, and long their banks at a depth of from 3 to 5 feet.

(b). It is overlaid by clay, sand and soil.

(c). Its upper surface is level, the lower appears to be slightly inclined.

(d). It is imbedded in a garnetiferous sand, with coarse and fine water worn quartz pebbles.

(e). The slopes of the enclosing hills vary within wide limits from $\frac{1}{10}$ (0.10, $5\frac{3}{4}^{\circ}$) to $\frac{1}{20}$ (0.50 $2\frac{5}{6}^{\circ}$) and below $\frac{1}{20}$.

(f). The thickness of the stratum of Phosphate Rock varies from 8 to 12 inches.

From some experiments which I have made in manufacturing this rock into superphosphate, I am inclined to think well of it. It takes kindly to sulphuric acid, and dries well. Whether it can be used or not on a large scale remains to be seen.

Laboratory Navassa Guano Company,
Wilmington, N. C.

NORTH CAROLINA PHOSPHATES.

CHARLES W. DABNEY, JR.

History.—All the writers upon North Carolina geology have referred to the coprolites found in the coal stratas and in the marl beds. Dr. Emmons, in his report published in 1852 (p. 46) mentions the coprolites in the marl on the south of the Cape Fear and one-half mile below Elizabeth City. The specimen he analyzed contained 71.59 per cent. of phosphate of lime and 9.68 per cent. of sand. He describes them as rounded or spiral in form, and concludes that they must be true coprolites and not pseudo-coprolites or modified marls, as the distinction was in his day. On p. 63 of the same report, he mentions coprolites as occurring in the marl on the banks of the Tar at Greenville. Dr. Emmons refers, on p. 6, to the coprolites of the coal and marl in the following words:

"They do not exist in sufficient abundance in either formation to warrant the expense of extracting them; still the facts are important and should never be forgotten."

The knowledge of the subject remained virtually in this condition from that time (1852) to February, 1883, when the writer had the beds at Castle Hayne, New Hanover county, opened and examined.

Dr. Kerr refers to the coprolites in the marl beds in two places. On 193 of his Geology of North Carolina, 1875, Vol. I, he says, speaking of the specimen of marl from Dr. Roberts, near Mount Olives, Wayne county:

"It is a good representative of the marl beds of the immediate neighborhood. * * * In this region the eocene marl has been commingled with a considerable percentage of the underlying greensand, and contains numerous sharks' teeth, rounded fragments of bones and coprolites."

In another place he refers to the small coprolites in the marl in the north bluff of Waccamaw Lake, Columbus county. He says:

"The lower portion * * contains many black, smooth phosphatic (probably coprolitic) nodules. Such nodules are of frequent occurrence in the marls of both this and the preceding age—miocene and eocene; they are of no more value agriculturally than so many flint pebbles, unless ground and treated with acid."

Dr. Kerr evidently adopts the views of Dr. Emmons in full, and, believing them to be only the stray specimens of the true coprolites or fossil excrements which may be found in any of the later formations, attached no importance to them. Such coprolites, sprinkled through a number of formations, seldom occur in sufficient quantity to be of interest industrially. These writers do not appear to have known of the existence of phosphates bedded in layers similar to the South Carolina phosphates, and distinguished from the true coprolites as pseudo-coprolites (the phosphatized marls of Holmes).

Distribution.—Since my investigations started, phosphate rock has been found so far (January, 1884,) in larger or smaller quantities, in Sampson, Duplin, Onslow, Pender, New Hanover, Bladen, Columbus and Brunswick counties. The same rock probably extends into the southern portion of Wayne county, and possibly into Lenoir and Jones.

The Phosphatic Conglomerates of Pender and New Hanover.—The phosphatic rock is found in two distinctly different relations. In the lower country, as in Pender and New Hanover, we find rounded, phosphatic nodules imbedded in a shell marl, which all of the writers on North Carolina geology have classed as Eocene. At Castle Hayne, for example, this bed occurs from one to four feet below the surface and four to five feet thick. It looks just as if the water-worn phosphatic nodules, sharks' teeth and quartz pebbles had been deposited here upon the bottom of the sea, and that the broken and ground-up shells which were deposited on top of them had then filled all the interstices and cemented them together. At places, where the smallest nodules are deposited, the shell-powder did not reach the bottom of the layer, and we find loose nodules at the bottom. At other places the shell-powder did not suffice to cover the layer, and we have a lot of loose nodules on top. At another place the lime deposit rises far above the layer of nodules, and we find a limestone, nearly pure carbonate, on top. The lime formation evidently had a different niveau from the nodule bed, as we find it at many places without a trace of the nodules. The bedding of the nodules and the lime did not go on exactly together, therefore. We do not find nodules disseminated here and there through the carbonate of lime, as the coprolites are found in the marl beds, but we find the nodules touching in the layer and the powdered-shell only filling the interstices.

These nodules are of all conceivable sizes, from the size of a pumkin to a grain of wheat, though mostly about the size one's fist, and rounded or kidney shape. They are all considerably water_ worn, and they are bedded with water-worn pebbles, sharks' teeth, and pieces of bone. Their composition is peculiar and renders the supposition that they are coprolites in anything like their original condition untenable. The characteristic thing about all of them is 20 to 50 per cent. of silica, as rather course, sharp-grained sand. They are by no means of uniform composition. The two chief variants are the insoluble matter (sand) and the phosphate of lime. The phosphate of lime varies from 10 to 60 per cent. The following complete analysis shows the composition of one of them taken at random. It proves one of the poorest ones :

Insoluble matter (sand)	43.66
Carbonate of lime	34.56
Magnesia	0.86
Potash and soda	0.39
Oxide of iron and alumina	0.56
Phosphate of lime	19.99
Sulphuric acid	trace.
Chlorine	trace.
	100.02

Another specimen contained 31.66 per cent. of insoluble matter, 15.94 of carbonate, and 42.09 of phosphate of lime.

Nodules representing the extremes in composition are found side by side. While they are all characterized by the same general properties, and especially by this coarse sand, one can find in a cubic foot of this conglomerate every grade of phosphate nodule. All are more or less impregnated with the carbonate of lime and some contain as much as 40 per cent. The conclusion seems irresistible that this is not the first estate of the nodules. They would appear to be the result of the breaking up, wearing, commingling and rebedding of phosphate beds of different localities. The bedded phosphates, which their composition shows these nodules represent, never vary so much in composition in the same bed. The various individuals found here must have come together from distinct and possibly widely separated beds.

The cement between the nodule is made from broken and, for the most part, finely-ground shells. It is mostly quite pure. At French Bros.' quarries, the lime deposit on top of the nodules gives from 95 to 97 per cent. of carbonate of lime. The cement broken from between the nodules at Castle Hayne was found to contain:

Sand and insoluble matter	3.04 per cent.
Carbonate of lime	90.80 "
Phosphate of lime	1.46 "

The Phosphate Rock of Sampson and Duplin.—The question suggested by the above : Whence came the original phosphate rock ? was quickly answered by the discovery in the up-country (in Sampson, Duplin and Onslow counties,) of continuous beds of phosphate of a similar character, separate and distinct from the lime formation. A gentleman from Duplin county sent me, August 7th, some pieces of dark, gritty phosphate, which he said existed there in a bed in large cakes and lumps. A visit to the location showed that they were the very things we were looking for. This phosphate varies in composition as did the first described, though it is mostly richer, on account of the impregnation of the former with carbonate of lime. It contains from 15 to 40 per cent. of coarse sand, 2 to 4 per cent. of carbonate of lime, and from 30 to 60, and even 70 per cent. of phosphate of lime, with smaller amounts of oxide of iron, alumina, magnesia, &c. The lumps occur in continuous horizontal layers, varying in depth from the surface to 15, and possibly 20 feet deep, the layer being usually 8 to 16 inches thick. The cakes and lumps have been partially dissolved and rounded at the corners. They are occasionally perforated, though not so frequently, or to anything like the same degree, as the South Carolina phosphates. The unbroken lumps weigh frequently 200 to 500 pounds; there are very few small ones, that is smaller than a hickory nut. The surface soil is a very sandy loam, the subsoil is a stiff or yellowish clay. The phosphate rock is found immediately underneath a stratum of 2 to 4 feet of this clay imbedded in a coarse sand. Underneath this is another stiff, fine-grained, blueish clay. At other places the rock occurs underneath the marl.

What the extent of these beds is it is impossible to say at present. The rock occurs mostly in the coves along the little creeks, and is exposed in the ditches, creek banks or marl pits, although in some localities it is upon the uplands. The rock of a given locality is of very uniform composition, though it varies considerably mile by mile. We find in this up-country rock corresponding to all of the different grades and qualities of the phosphate of the conglomerate beds of Pender and New Hanover. The two rocks can be shown to be similar, when sufficient allowance is made for the changes to which the rebedding has subjected the one and the action of the soil-waters in the porous sand has modified the other. There can be little doubt, then, that the phosphate first described came originally from beds similar to those existing to-day in Sampson and Duplin.

This is not the place to discuss the industrial features of this discovery. The possibilities ahead of us in this direction will be thoroughly tested by our State Board of Agriculture. It must be enough to say now that some of the poorest of this rock has already been shown, by the writer, to produce very good superphosphate, and that, as soon as the question of a sufficient supply is settled, large phosphate mining and manipulating works will be established in this section.

EXPERIMENTS AS TO THE AMOUNT OF BUTTER FROM WEIGHED AMOUNTS OF MILK.

JAMES P. KERR.

Some discussion having arisen as to how much butter could be gotten from a pound of milk, a series of experiments was undertaken to see if an answer could be given to the question. In these experiments the milk of several cows was mixed; the cows were partly thorough bred Devons and partly Devon and Jersey. In every case the milk of the same cows was taken. Two experiments were carried out early in the spring, the feed of the cows being carefully measured for several days prior to each experiment. In the first case 23.12 pounds milk or 10.86 quarts produced one pound of butter. In the second, 17.59 pounds or 8.28 quarts produced one pound of butter. These experiments were not made on consecutive days.

In the second series of experiments, the milk was taken for three consecutive days (April 28th, 29th, 30th).

Experiment 1.—Amount of milk taken was 40.5 pounds. This milk was kept at a temperature of 60° F. for two days, when it was churned. It was put into the churn at 60° F. and churned for nearly an hour, then it was gradually heated to 66° F. and churned forty minutes longer. The yield of butter was $1\frac{14}{16}$ pound.

Experiment 2.—Amount of milk $42\frac{3}{4}$ pounds. Management of milk the same as in Experiment 1, except the milk was put into the churn at 66° F. instead of 60° F. Time of churning 45 minutes. Amount of butter produced 2 pounds.

Experiment 3.—Amount of milk $42\frac{1}{8}$ pounds. Management of milk same as in 2°. Yield of butter $1\frac{1}{16}$ pounds.

SYNOPSIS OF EXPERIMENTS.

23 12	pounds	milk or	10.86	quarts	produced	1	pound	butter.
17.59	"	"	8.28	"	"	1	"	"
24.36	"	"	11.41	"	"	1	"	"
21.37	"	"	10.06	"	"	1	"	"
20.42	"	"	9.60	"	"	1	"	"

Average 21.35 pounds milk (10.04 quarts) produced 1 pound butter.

The approximate daily amount of food fed during the experiments and for two days prior to their beginning was as follows, viz: 12 lbs. cut food, consisting of 2 parts wheat straw and 1 part shucks; 13 lbs. corn-meal; $6\frac{1}{2}$ lbs. wheat-bran; 10 qts. cotton seed; green feed (short pasturage with a small feed of rye).

Haw River, N. C., April, 1884.

HYDRATED CARBON BISULPHIDE.

F. P. VENABLE.

This body discovered by Berthelot (Ann. Ch. Phys. [3] 46 490) and Wartha (Bull. Soc. Chim. [2] 8, 258) has been examined also by Duclaux (Ber. Chem. Ges. 3, 80) and by Ballo (Ber. Chem. Ges. 4, 118). The descriptions of it given in our text-books show, however, that our knowledge of it is still somewhat indefinite and incomplete. The following experiments, undertaken at first for purposes of class illustration, may serve to clear up some of the doubtful points concerning this body. In filtering carbon bisulphide, a sensation of decided cold will be noticed whenever the filter paper is touched. To determine the lowering of temperature caused by the rapid evaporation of the carbon disulphide, a thermometer bulb was wrapped with filter paper and then suspended over a shallow vessel dipped beneath the disulphide contained in it. The mercury sank rapidly to 18° c. and the paper became covered with a peculiar cauliflower like growth of a snow-white substance which was seen to be the same as that produced by forcing a current of air across the surface of the disulphide. In farther experiments with the thermometer the paper was discarded as uselessly cumbrous, the thermometer was hung just touching the liquid, and evaporation was started by blowing through a tube obliquely into the disulphide so that the little waves struck against the bulb. The formation of the snow-like solid soon commenced. The blowing could then be stopped, and the growth went on rapidly until it reached a height of 5-6 cm., above the surface. If a current of air was directed upon this growth, it increased most rapidly on the side exposed to the current, forming little tufts resembling miniature, compactly-formed trees and reaching in some cases a length of 7—8 mm. One point observed was that the amount of moisture in the air had a decided effect upon the ease of causing this formation and the rapidity of the growth.

A simple and effective mode of showing as a class experiment the abstraction of heat by the rapid evaporation of the disulphide, or more properly speaking, by the formation of the hydrate, is to take a small glass tube with thin walls about 90 m. m. long and having a diameter of 10 m. m. This tube is provided with a collar of copper wire having two projecting points which turn easily in the ends, bent into rings of a strong copper wire attached to a support. The ring of one of the ends of the longer and stouter wire should not be closed, so that the tube can be easily unmounted. This arrangement gives stability and the tube is much easier to tilt than when simply suspended by threads. The tube is wrapped with a single layer of filter paper for two-thirds its length, the paper extending about 1 cm. beyond the closed end. This lower edge dips just beneath the disulphide when the tube is in position. The tube is filled about half or two-thirds full of water, is placed in its swing and in a few minutes the water will be frozen and will not flow out when the tube is inverted. In one experiment, with the tube arranged as above, the water was frozen within four minutes. The original temperature of the water was 30° c., and the relative humidity of the surrounding atmosphere was 74 per cent.

Ballo has recorded one or two experiments to prove that this cauliflower-like growth is a hydrate and not solid frozen carbon disulphide. The following experiment confirms his results, and may be regarded, I think, as conclusive of the dependence of this body for its formation upon the moisture of the air. An open-necked bell-jar, ground, greased and tightly fitting to a ground glass plate, was provided with a large rubber stopper which was pierced with two holes. Through one of these a calcium chloride tube was inserted, through the other a glass tube with a glass rod working tightly in it and bound to it means of rubber tubing so as to be air-tight. The calcium chloride tube was 250 mm. long, and was filled with freshly dried calcium chloride. Inside the bell-jar, a glass acid-holder was filled with concentrated sulphuric acid and on a triangle placed over it was supported a watch glass containing carbon disulphide purified by the method of Cloez (Compt. rend. 69, 1356). The glass rod had attached to it by a bit of wax a strip of filter paper 25 mm. broad, 100 mm. long, which had been previously dried in an air-bath for two hours at 100°—105° c. After this was put in the bell-jar, the latter was fitted tightly to the glass plate and the whole allowed to stand about thirty minutes so that every trace of moisture might be removed from the enclosed air. At the expiration of this time, the slip of paper was lowered by the movable rod until it touched the carbon disulphide. The liquid rose rapidly in the pores of the paper, but even after some minutes no sign of the solid incrustations could be seen. As the confined space might have interfered with the evaporation, an aspirator was attached to the calcium chloride tube, but no formation of the solid could be induced. The sulphuric acid was then taken from the jar and water substituted for it. The solid commenced to form almost immediately after the lowering of the paper. The liquid did not rise quite so high as in the first case, and aspirating increased the rate of formation but slightly. If the aspiration was continued until the jar was filled with aqueous vapor, the solid formation suddenly and completely melted away.

Several different ways were tried of forming this hydrate. First, carbon disulphide mixed with about 25 per cent. of water, in a test tube, was placed in a mixture of ice and hydrochloric acid (—23° c.), and for purposes of comparison a tube containing distilled water was placed beside it. The first tube became very milky and turbid and was frozen to an opaque solid; in the second tube the water remained transparent until completely frozen. A second tube of water and the disulphide was stirred whilst freezing, so as to freeze only on the sides and leave a channel open from the bottom to top. All that refused to freeze was poured out, the tube corked and its contents melted. After melting, a layer of disulphide was observed beneath the water. Of course no great reliance can be placed on such an experiment alone, as the oil may have been mechanically entangled and retained. Again, if a few c.c. of carbon disulphide be poured through 2-3 cm. of 90 per cent. alcohol in a tube the two form clear and distinct layers. Let this tube gently down into a freezing mixture of ice and hydrochloric acid and the carbon disulphide becomes turbid, while delicate cloud-masses form in the alcohol and if the alcohol contains more than 10 per cent. water, it becomes milky and opaque. These cloud-masses disappear above -10° or -9° c., but the temperature could not be accurately fixed as it seemed to depend upon the amount of carbon disulphide and water held in suspension or solution. If the alcohol and disulphide stand for some time, all disulphide apparently settles out as the cloudiness cannot be again produced by cooling. Care was of course exercised to prevent any agitation or mixing of the liquid layers in sinking the tube into the freezing mixture. A mixture with ether containing a small percentage of water gave also a turbid appearance on being cooled, but the layers were not distinct, nor, on taking the tube from the freezing mixture, did the cloudiness disappear so easily as in the case of the alcohol. Experiments with it then could not be so easily observed nor so rapidly repeated.

The temperature of formation or decomposition given by Wartha (-12° c.) needs additional data to make it correct, according to the following experiments. Even when evaporation and the formation of hydrate was rapidly going on in a shallow watch glass full of the disulphide, the temperature of the liquid itself did not fall below -6° c. For these experiments a Geissler thermometer graduated to $\frac{1}{10}$ degrees was used, the bulb was nearly spherical and from its under-surface a small bead of glass projected. With this bead touching the surface of the carbon disulphide and the evaporation started by blowing upon it for a short time, the incrustations soon covered the bulb and the mercury sank rapidly to about 9°c. It then sank very slowly. Seemingly more carbon disulphide was drawn upon the bulb than was used in forming the solid, as the latter had an oily appearance and this probably tended to keep up the temperature. If the thermometer was raised entirely above the liquid the oily look disappeared, the tufts of the solid, before thick and short, branched and grew stiff and strong while the mercury rapidly sank to a constant point. To determine this point, then, the solid was allowed to form over the bulb and some extra disulphide was taken up. By a crank arrangement the thermometer was then raised several inches above the surface of the liquid and the lowest temperature reached noted. The stay at this point sometimes lasted one or two minutes before the rapid rise commenced. If the thermometer was blown upon whilst the mercury was sinking, the temperature could be reduced several degrees below the point of decomposition. If the constant point had been reached and the mercury was beginning to rise, even if only $\frac{1}{10}$ degree, blowing caused a very rapid rise and melting of the hydrate. The lowest temperature reached by blowing was—19.5°C., the relative humidity of the room being 75. When the thermometer was wrapped with filter paper and this dipped in disulphide, the reduction went on regularly to the constant point of decomposition. The slow sinking at -9 C. was not noticed.

Several observations showed that the reduction was in a measure dependent upon the relative humidity of the surrounding atmosphere. This was determined at each observation of the point of decomposition, but the experiments could not be made accurately enough to deduce any fixed law. Air saturated with moisture gave no hydrate. From this point the temperature of decomposition seemed to sink, the lowest points being reached when the air contained between 70 and 80 per cent. of moisture. Below 60 per cent. the temperature in a number of observations rose once more. Even if the current of air was too slight to affect a small candle flame, it would still show upon the delicate thermometer used, the variations caused being shown by shielding the bulb on one side or the other. Entire surrounding and protection of the bulb interfered with the evaporation, and of course the evaporation itself caused currents. Some other way must then be devised for determining this point. Guarding against draughts as carefully as possible, the determinations made, some twenty-five or thirty in all, ranged from —14°C. to —17°C. No point such as that mentioned by Wartha (—13°C.), to which the mercury would rise and remain constant, was observed, the rise being rapid and regular till the temperature of the room was reached. Berthelot gives the point of decomposition as about —3°C.

Chemical Laboratory, U. N. C.

NOTES ON THE INDIAN BURIAL MOUNDS OF EASTERN NORTH CAROLINA.

J. A. HOLMES.

So far as is known to me, no account of the Indian burial mounds, which are to be found in portions of Eastern North Carolina, have, as yet, been published. This fact is considered a sufficient reason for the publication of the following notes concerning a few of these mounds which have been examined in Duplin and a few other counties in the region under consideration.

It is expected that the examination of other mounds will be carried on during the present year, and it is considered advisable to postpone generalized statements concerning them until these additional examinations have been completed. It may be stated, however, of the mounds that have been examined already, that they are quite different from and of much less interest, so far as contents are concerned, than those of Caldwell and other counties of the western section of the State. As will be seen from the following notes, they are generally low and rarely rising to more than three feet above the surrounding surface, with generally circular bases varying in diameter from 15 to 40 feet; and they contain little more than the bones of human (presumably Indian) skeletons, arranged in no special order. They have been generally built on somewhat elevated, dry, sandy places, out of a soil similar to that by which they are surrounded. No evidence of an excavation below the general surface has as yet been observed. In the process of burial, the bones or bodies seem to have been laid on the surface or above, and covered up with soil taken from the vicinity of the mound. In every case that has come under my own observation charcoal has been found at the bottom of the mound.

Mound No. 1—Duplin county, located at Kenansville, about one-half mile southwest from the courthouse, on a somewhat elevated, dry, sandy ridge. In form, its base is nearly circular, 35 feet in diameter; height 3 feet. The soil of the mound is like that which surrounds it, with no evidence of stratification. The excavation was made by beginning on one side of the mound and cutting a trench 35 feet long, and to a depth nearly 2 feet below the general surface of the soil, (5 feet below top of mound) and removing all the soil of the mound by cutting new trenches and filling up the old ones. In this way all the soil of the mound and for two feet below its base was carefully examined. The soil below the base of the mound did not appear to have been disturbed at the time the mound was built. The contents of the mound included fragments of charcoal, a few small fragments of pottery, a hand-full of small shells, and parts of sixty human skeletons. No implements of any kind were found. Small pieces of charcoal were scattered about in different portions of the mound, but the larger portion of the charcoal was found at one place 3 or 4 feet square near one side of the mound. At this place the soil was colored dark, and seemed to be mixed with ashes. There were here with the charcoal, fragments of bones, some of which were dark colored, and may have been burned; but they were so nearly decomposed that I was unable to satisfy myself as to this point. I could detect no evidence of burning in case of the bones in other portions of the mound. Fragments of pottery were few in number, small in size, and scattered about in different parts of the mound. They were generally scratched and cross-scrated on one side, but no definite figures could be made out. The shell "beads" were small in size—10 to 12 mm. in length. They are the *Marginella roscida* of Redfield, a small gasteropod which is said to be now living along the coasts of this State. The specimens, about 75 in number, were all found together, lying in a bunch near the skull and breast bones of a skeleton. The apex of each one had been ground off obliquely so as to leave an opening passing through the shell from the apex to the anterior canal—probably for the purpose of stringing them.

The skeletons of this mound were generally much softened from decay—many of the harder bones falling to pieces on being handled, while many of the smaller and softer bones were beyond recognition. They were distributed through nearly every portion of the mound, from side to side, and from the base to the top surface, without, so far as was discovered, any definite order as to their arrangement. None were found below the level of the surface of the soil outside the mound. In a few cases the skeletons occurred singly, with none others within several feet; while in other cases several were found in actual contact with one another; and in one portion of the mound, near the outer edge, as many as twenty-one skeletons were found placed within the space of six feet square. Here, in the case last mentioned, several of the skeletons lay side by side, others on top of these, parallel to them, while still others lay on top of and across the first. When one skeleton was located above another, in some cases the two were in actual contact, in other cases they were separated by a foot more of soil.

As to the position of the parts of the individual skeletons, this could not be fully settled in the present case, on account of the decayed condition of many of the bones. The following arrangement of the parts, however, was found to be true of nearly every skeleton exhumed: The bones lay in a horizontal position or nearly so. Those of the lower limbs were bent upon themselves at the knee, so that the thigh bone (femur) and the bones of the leg (tibia and fibula) lay parallel to one another; the bones of the foot and ankles being found with or near the hip bones. The knee cap or patella, generally lying at its proper place, indicated that there must have been very little disturbance of the majority of the skeletons after their burial. The bones of the upper limbs, also, were seemingly bent upon themselves at the elbow; those of the fore-arm (humerus) generally lying quite or nearly side by side with the bones of the thigh and leg; the elbow joint pointing toward the hip bones, while the bones of the two arms below the elbow joint (radius and ulna) were in many cases crossed, as it were, in front of the body. The ribs and vertebræ lay along by the side of, on top of, and between the bones of the upper and lower limbs; generally too far decayed to indicate their proper order or position. The skulls generally lay directly above or near the hip bones, in a variety of positions; in some cases the side, right or left, while in other cases the top of the skull, the base or front was downward.

But two of the crania (A and B of the following table) obtained from this mound were sufficiently well preserved for measurement; and both of these, as shown by the teeth, are skulls of adults. C of this table is the skull of an adult taken from mound No. 2, below.

Crania.	Length.	Breadth.	Height.	Index of Breadth.	Index of Height.	Facial Angle.
A	193 mm.	151 mm.	144 mm.	.746	.746	74°
B	172 mm.	133 mm.	136 mm.	.772	.790	66°
C	180 mm.	137 mm.	147 mm.	.761	.816	63°

The skeletons were too much decomposed to permit the distinguishing of the sexes of the individuals to whom they belonged; but the size of the crania (adults) and other bones seem to indicate that a portion of the skeletons were those of women. One small cranium found was evidently that of a child—the second and third pair of incisor teeth appearing beyond the gums.

Mound No. 2, located 1¾ miles east of Hallsville, Duplin county, on a somewhat elevated, dry, sandy region. Base of mound nearly circular, 22 feet in diameter; height, 3 feet, surface rounded over the top. Soil similar to that which surrounds the mound—light sandy. Excavations of one-half of the mound exposed portions of eight skeletons, fragments of charcoal and pottery, arranged in much the same way as described above in case of mound No. 1. The bones being badly decomposed, and the mound being thoroughly penetrated by the roots of trees growing over it, the excavation was stopped. No implements or weapons of any kind were found. There was no evidence of any excavation having been made below the general surface, in the building of the mound, but, rather evidence to the contrary. The third cranium (C) of the above table was taken from this mound.

Mound No. 3, located in a dry sandy and rather elevated place about one-third of a mile east of Hallsville, Duplin county. In size and shape, this mound resembles those already mentioned. Base circular, 31 feet in diameter; height 2½ feet. No excavation was made, other than what was sufficient to ascertain that the mound contained bones of human skeletons.

Mound No. 4, Duplin county, located in a rather level sandy region, about one mile from Sarecta P. O., on the property of Branch Williams. Base of mound circular, 35 feet in diameter; height 2½ feet. Soil sandy, like that which surrounds it. Around the mound, extending out for a distance varying from 5 to 10 yards, there was a depression, which, in addition to the similarity of soils mentioned above, affords ground for the conjecture that here, as in a number of other cases, it is probable the mound was built by the throwing on the soil from its immediate vicinity. Only a partial excavation was made, with the result of finding human bones, and a few small fragments of charcoal and pottery.

Since the above mounds were visited, I have obtained information as to the localities of mounds similar to those described, in the eastern, southern and western portions of Duplin county; and I can hardly doubt but that a closer examination of this region will prove them to be more numerous than they are now generally supposed to be.

In Sampson county, the localities of several mounds have been noted; but one of these, however, so far as I am informed, has been examined with care. This one (Mound No. 5), examined by Messrs. Phillips and Murphy of the Clinton School, is located about 2½ miles west of Clinton (Sampson county), on the eastern exposure of a small hill. In general characters it resembles the mounds already described. Base circular, 40 feet in diameter; height 3½ feet; soil sandy loam, resembling that surrounding the mound. Contents consisted of small fragments of charcoal, two bunches of small shell "beads," and the parts of 16 human skeletons. These skeletons were not distributed uniformly throughout the portion of the mound examined. At one place there were 9, at another 6, and at a third place 5 skeletons, lying close to, and in some cases on top of one another. In this point as in the position of the parts of the skeletons ("doubled-up") this mound resembles those described above. The bones were generally soft from decay. The small shells were found in bunches under two skulls; they are of the same kind (Marginella roscida, Redfield) as those from Mound No. 1. and their ends were ground off in the same way. No bones were found below the surface level, and there was no evidence of excavations having been made below this point. No stone implements of any kind were found in the mound. One-half this mound was examined.

In Robeson and Cumberland counties several mounds have been examined; and for information concerning these, I am indebted to Mr. Hamilton McMillan, of Dora, Robeson county. Five mounds are reported as having been examined in Robeson county, averaging 60 feet in circumference, and 2 feet high, all located on elevated, dry ridges, near swamps or water-courses; and all contained bones of human skeletons. One of these mounds, located about two miles east of Red Springs, examined by Mr. McMillan, in 1882, contained about 50 skeletons. Many of these bones near the surface of the mound, in Mr. McMillan's opinion, had been partly burned—those nearer the bottom were in a better state of preservation. There was an "entire absence of skulls and teeth" from this mound—a somewhat remarkable fact. A broken stone "celt" was found among the remains; but with this one unimportant exception, no mention has been made of implements having been found.

In addition to the above, Mr. D. Sinclair, of Plain View, Robeson county, has informed me that he has seen four mounds in the southern portion of this county—two near Brooklyn P. O., and two between Leesville and Fair Bluff, about five miles from the latter place.

In Cumberland county, two mounds are reported by Mr. McMillan as having been examined. One of these located about ten miles south of Fayetteville, was found to contain the crumbled bones of a single person, lying in an east and west direction. There was also found in this mound a fragment rock rich in silver ore. The other mound, located ten miles southwest from Fayetteville, near Rockfish Creek, was examined by Mr. McMillan in 1860, and found to contain a "large number of skeletons,"—"bones were well preserved and, without exception, those of adults." The mound was located on a high sandy ridge, its base about 20 feet in diameter; height 2½ feet.

In Wake county one mound has been reported as being located on the northeast and several on the southwest side of the Neuse River, about seven miles east from Raleigh; and from the former it is stated that large numbers of stone implements have been removed. But I have been unable to examine these or to obtain any definite information concerning them. One mound in this county, examined in 1882 by Mr. W. S. Primrose, of Raleigh, is worthy of mention in this connection, as it resembles in general characters the mounds of Duplin county. This mound is located about ten miles south of Raleigh, on a small plateau covered with an original growth of pines. Base of mound circular, about 14 feet in diameter; height 2 feet. The contents of the mound consisted of small fragment of charcoal, and the bones of 10 or 12 human skeletons, much decayed, and arranged, so far as could be determined, without any reference to order or regularity. No weapons or implements of any kind were found.

NOTE ON CASSITERITE FROM KING'S MOUNTAIN, N. C.

CHARLES W. DABNEY, JR.

Mr. Robert Claywell, a student from Burke county at the high school at King's Mountain, on the line between Cleveland and Gaston counties, found in a street of that village a piece of mineral, which he sent me for determination.

A specimen which Mr. Claywell gave Col. S. McD. Tate was sent me by that gentleman along with some other minerals, listed by the words, "No ——, Tin ?" Still other specimens fell into the writer's hands while in Burke county in July last collecting for the Boston Exposition, which also undoubtedly came from Mr. Claywell, who was the first to recognize it as a new mineral, unknown to him. These specimens were determined by the writer to be massive cassiterite, the first found in this State.

It was not known to me at first where the mineral came from, and I supposed they were isolated specimens from the gold bearing gravel. In January, Mr. Claywell communicated to me through a friend the source of the specimens. Ascertaining that there was a considerable amount of it scattered through the surface-soil there, I visited the locality and instituted some explorations.

My expectations were more than verified when I found pieces of Cassiterite from the size of an egg to the finest sand, loose and sticking in quartz, scattered over the surface in a belt beginning about the centre of the village, and extending southward a mile or more.

When the clay of the hills or the gravel of the neighboring creeks was panned, a heavy black sand was obtained which yielded more or less tin.

A number of shafts have been sunk and trenches dug along the course of the hill-tops whence the tinstone appears to have come. The rocks are mica schist and slate, with frequent veins and streaks of quartz and quartzyte. The rocks are nearly vertical, direction of out-crop northeast and southwest with all of the rocks of this country. The tinstone is disseminated through the quartz and quartzyte vein matter occurring in a belt of the rock 100 to 150 yards wide. The chief tin-bearing territory is limited on the northwest by a large out-crop of micaceous quartzyte, on the southeast side by very large out-crop of tourmaline–bearing or massive tourmaline–stained quartzyte.

A number of these tin-bearing quartz veins have been exposed in this territory. The surface is covered with fragments of them which the decaying mica schist and slate have left. These veins are from 2—4 feet in width. They run mostly with the other rocks, though there are frequent cross and string-veins. At places these quartz or quartzyte veins are left by the mica schist and stand up through the clay nearly to the surface, while at other places they are broken down to the level of the mica schist. At still other places where the schists and slates contained more silica, the whole formation is found now near the surface.

According to Dr. Emmons, the village of King's Mountain is near the dividing-line between the Laurentian granite and the Huronian slates. To the east of the village the rocks are micaceous and slaty quartzytes, talcose slates and bluish crystalline limestone. A few miles west are the hornblende slates, gneiss, etc.

Nearly all of the adjacent rocks, the mica schists and slates, the tourmaline-bearing quartz, and the massive black quartz—all show amounts of tin varying from distinct traces to 1—2 per cent.

The only remark on tin which I find in writings on North Carolina mineralogy is the following from Dr. Genth (Mineralogy of North Carolina): "No tin ore has been found in North Carolina as yet; traces of this metal have been found in the tungstates of Cabarrus county, *and in a micaceous slate* (Huronian) *in Gaston county*, associated with garnet and columnar topaz." [The italics and parenthesis are mine.] The observation is very interesting in the light of the recent discoveries. Have we not here at King's Mountain, at or near the junction of these slates and the older gneiss and granite a concentration of this diffused tin ?

The Cassiterite is mostly massive or semi-crystalline; occasionally crystals are found. Hardness, 6.5 to 7; Specific gravity, 6.6 to 6.9; color, generally dark brown, but varying from this to light yellow and cream-colored, or almost colorless. Composition, mostly an impure Cassiterite, with 50 to 60 per cent. of tin, some dark brown silicious specimens running as low as 46 per cent. of tin. The somewhat rarer light colored specimens are richer in tin coming nearer the per cent. of metal (78.66) in pure dioxide of tin (SnO_2).

Out of a large number of analyses, I take the following, pretty much at random:

1. Is a rather light-colored (not the lightest I have seen, however,) yellowish specimen, with a high lustre and distinctly marked cleavage.

2. Is a rich brown-colored specimen, not the darkest. Analyzed by Prof. G. B. Hanna, U. S. Assay office, Charlotte, for me.

	1. Light-colored.	2. Rich brown-colored.
Silica	1.76 per cent.	2.36 per cent.
Arsenic	none.	trace.
Sulphur	trace.	0.46 per cent.
Iron	0.62 per cent.	1.76 "
Tungstic acid	0.92 "	1.14 "
Tin (by wet method)	74.41 "	(by fusion) 65.21 "

The tinstone is remarkably free from those worst ingredients of tin ore, sulphur and arsenic. The lower-grade specimens do not show appreciably more than the above.

The accompanying minerals are tourmaline, very abundant; titanic iron in more immediate relation with the Cassiterite; lithia mica, generally immediately around the larger lumps of the tinstone in the quartz; and more rarely zirkon and rutile.

Raleigh, N. C., February, 1884.

NOTES.

TEMPERATURE OF WELL WATERS IN CHAPEL HILL.

Observations were taken during one year about the middle of every month, excepting July. A very accurate Geissler thermometer was used, graduated into tenths of a degree. The wells examined were College (1), Dr. Phillips' (2), Prof. Venable's (3), Mrs. Hendon's (4), Prof. Manning's (5), and President Battle's (6). These vary considerably in depth and most probably tap different strata. The following table gives the results of the observations :

SEASONS.	1	2	3	4	5	6
Spring	58.5	58.2	58.9	58.3	57.6	55.9
Summer	90.2	59.8	60.5	----	59.8	58.6
Fall	59.5	59.1	59.7	59.8	58.8	58.5
Winter	58.0	57.0	58.1	56.8	55.5	55.8
Annual	59.1	58 5	59.3	59.1	58.1	57.2

University of North Carolina. F. P. VENABLE.

ELEVATION OF CHAPEL HILL.

Determined by computation (using Guyot's tables) from Barometric observations for the year September, 1882, to August, 1883, inclusive, taken at Wilmington, Charlotte and Chapel Hill; and determining approximately the correction to be made by comparing the known elevation of Charlotte with the computed elevation.

Elevation of Chapel Hill by comparison with Wilmington is 494.56 feet.

By comparison with Charlotte, it is 495.84 feet.

Mean of the two computations is 495.2 feet.

Known elevation of Charlotte is 838 feet.

Computed elevation of Charlotte by comparrison with Wilmington 806.61 feet.

Difference = 31.39 feet.

Making proportional correction to the computed elevation of Chapel Hill, which is found to be 13.27 feet, we have an approximate elevation of Chapel Hill 514.47 feet.

Chapel Hill, N. C. J. W. GORE.

ANALYSIS OF ROCK-SALT FROM SALTVILLE, VA.

A specimen of this rock-salt sent by the Superintendent of the salt-works in the valley of the Holston, yielded on analysis somewhat different results from the previously published analysis (Chem. News, No. 1038) and in view of this and the claim made for this Virginia brine, that it exceeds in purity nearly all others of which analyses are on record, the analysis made in this laboratory is published. The specimen was brownish-red in color, with a crystalline structure and was obtained whilst deepening one of the salt-wells. This rock-salt is not mined, the brine alone being used for the manufacture of salt. The capacity of the works is at present 450,000 bushels per year, though at one time, during the late war, the yield was as high as 10,000 bushels per day.

According to this analysis the rock-salt contained :

$NaCl$	93.05
KCl	trace.
$CaSO_4.2H_2O$	2.40
$MgSO_4$	.07
Fe_2O_3	.83
SiO_2	2.81
H_2O	.30
	99.46

An analysis of the salt as marketed gave 98.89 per cent $NaCl$ with a small perentage of $CaSO_4 2H_2O$ and a trace of $MgSO_4$ showing it to be a high-grade salt.

Chemical Laboratory, U. N. C.

THOS. RADCLIFFE.

THE STORM OF APRIL 22D, 1883.

This storm is remarkable for its excessive rain-fall. The barometer fell slowly on on 21st and between three and four-tenths on 22nd. The depression lasted during 23rd and 24th. The temperature was normal before and at time of storm, but a fall of 16°F. in daily mean followed it. The percentage of moisture in the atmosphere on 21st was lower than for two weeks previous. A rapid rise in this percentage was noticed on 22nd and the air remained nearly saturated until 24th, when there was a sudden falling off. Surface winds were light during 21st and 22nd coming from S. E. The cirrus clouds moved from N. W. during 20th and 21st, lower clouds from S. W. During 22nd the air felt "close" and the clouds were threatening, though not very heavy. They were flying fast and at times veered westerly. Towards nightfall they massed heavily in the west. Velocity of the wind was ten miles per hour and this remained nearly constant throughout the storm. Discharge of electricity was very vivid and the thunder violent. Precipitation began at 11 P. M. and lasted in its greatest violence until 1 A. M., or a little later. By 2 A. M. it had lulled into a gentle rain lasting into the next day. At the time of greatest rainfall the wind fell off to four miles per hour. The rainfall during the night was 4.19 in. This is the largest recorded at this Station. The damage done in the immediate vicinity was great. All mill-dams and bridges on neighboring streams were washed away. Haw River, Deep River, and the Neuse were reported deeper than in many years before.

Referring to the charts of the U. S. Signal Service, we see that this storm approached from the N. Pacific coast on the 18th and swept across the country. Violent local storms and tornadoes were reported South and East, especially in the Mississippi and Georgia. Dangerous gales were reported off the coast from Jacksonville, Fla., to Boston, Mass. Nine Stations in different parts of the State reported a rainfall of over three inches, showing the storm to be very general. Two tornadoes were reported also, one in Martin county, and one in Sampson county.

The auroral display on the 24th, following the storm, was very widely observed and was especially noted for the southerly latitudes in which it was seen. It was rather faint at Chapel Hill being visible between 8 and 9 P. M.

University Meteorological Station. F. P. VENABLE.

ANALYSIS OF A DEPOSIT OF ZINC OXIDE.

As is well known these deposits of impure zinc oxide are some times found in furnaces where zinc-bearing ores are used. The name cadmia is given them in Dana's mineralogy. The green flame of burning zinc is noticed at the tymp of these furnaces and was formerly looked upon by furnace-men as indicative of sulphur—especially as this burning left on substances in the near neighborhood of the tymp a coating of zinc oxide which was yellow whilst hot. The specimen examined was sent through the courtesy of the manager of the Longdale Iron Co.'s furnaces. According to analysis no zinc is contained in the ores used by this Company, the said ores being ordinary brown hematite. Nor has zinc been found in the coke and limestone used—evidently occurring then in minute traces, probably in the ore. The deposit was very large, nearly choking the mouth of the furnace. The specimen had a laminated appearance, as if deposited in layers, and was greenish-brown in color. It was quite hard, breaking in thin plates, like shale, in the direction of the lamination and the specific gravity was 5.0405 (temp. of water 16°C.).

The analysis gave :

ZnO	93.34
PbO	2.37
Fe (metallic)	1.09
$CaCO_3$	1.01
C	.20
SiO_2	1.11
	100.02

Chemical Laboratory, U. N. C. THOS. RADCLIFFE.

CAFFEIN IN YEOPON LEAVES.

Having in my possession a small sample of the leaves of the Yeopon (gathered in January), a qualitative examination for Caffein was made. The leaves were boiled with water for one to two hours (condensing the water in an upright cooler). This infusion was neutralized with magnesia then shaken with chloroform and the two layers of liquid separated. The chloroform was then evaporated off and the residue purified by dissolving in alcohol, then in water, and lastly in alcohol once more. The residue thus purified was .31 per cent. of the whole dried at 100°C.,.but the original sample was so small that no great reliance could be placed on these figures.

The residue was carefully compared with caffein from Powers & Weightman, and presented a close resemblance to it in every respect. It was sparingly soluble in water, more so in alcohol and quite so in chloroform. It gave a very distinct murexid reaction.

When a larger sample of the leaves can be obtained at a more favorable time of the year, a thorough quantitative examination will be made.

Chemical Laboratory, U. N. C. F. P. VENABLE.

FILTERS WASHED WITH HYDROFLUORIC ACID.

The removal of silica from filters by washing with hydrofluoric acid was first recommended by Austen (Zeitschr. Anal. Chem.). Acting upon this suggestion, Schleicher & Schull have prepared since Spring of 1883, filters washed with both hydrochloric and hydrofluoric acid. An examination of these filters shows that the ash can in most cases be disregarded. The published analysis gives the ash of a 11 c. m. filter as 0.00017 grm. Burning five and weighing on a fair balance gave 0.0002 as the weight of one ash. They are a little difficult to burn thoroughly. The average weight of the dried filter, same size, is 0.6284. The washing with hydrofluoric acid has decreased to a slight extent the power of retaining fine precipitates. The unwashed paper of the same number and grade fail to catch such a precipitate as calcium oxalate, even after standing several hours, that is, the first few drops are turbid. With the washed filters the turbidity is greater and more lasting. Several sets of experiments were carried out with papers from different packs, some procured from Germany, some from the New York agents, and it was found that all ordinary difficult precipitates except calcium oxalate were retained when the proper precautions were taken, the filtrate running through with great rapidity. The folding of the filters must be done carefully, as they break somewhat easily. The filter fibres, too, are apt to rub off. When accurately fitted, with a platinum cone, to a funnel in a filtering flask, they were found to stand well the pressure caused by an ordinary water air-pump. The head of water was about twenty-five feet. The advantages of these filters then are the rapidity of filtering and the extremely low ash-weight. The disadvantages are the ease of breaking and the necessity of care to prevent the passage of certain fine precipitates.

Chemical Laboratory, U. N. C. F. P. VENABLE.

OCCURRENCE OF ABIES CANADENSIS AND PINUS STROBUS IN CENTRAL NORTH CAROLINA.

Abies Canadensis, Michx. (Hemlock Spruce).—In many parts of the mountain region of North Carolina this tree occurs in considerable abundance—especially in the mountain valleys, along the borders of streams and swamps; and it has been observed about the base of mountains at some distance east of the Blue Ridge proper. So far as I am aware, however, it has not been recorded as occurring at any point east of the "Mountain Region." Recently I was informed that a few small trees of this species were to be found growing in Wake county, on Swift Creek, about ten miles southwest from Raleigh, and on visiting that place I found the real Abies Canadensis growing there, at an elevation of not more than 350 feet, latitude a little south of 56°. The locality was the northern exposure of a bluff about 100 feet high and 350 yards long, extending in a nearly east by west course, with its eastern end curved around toward the northeast and its western toward the northwest, thus quite effectively shutting out a portion of the sun's heat.

There were four or five trees growing on this northern exposure that measured 12 to 15 inches in diameter near the base, and about 50 feet high. These with several smaller individuals were all that could be found. The larger trees do not present a heathy, vigorous appearance; and are quite certain to be shortlived. The smaller trees are few in number.

Pinus Stobus, L. (*White Pine*).—Distribution in mountain region of the State much the same as that of the Hemlock Spruce, mentioned above; and like that tree the White pine has not, so far as I know, been recorded as occurring at any point in this State east of the "Mountain Region." Recently, however, as reported to me by several reliable persons, it has been found in Chatham county, growing on the northern exposure of the steep, rocky, southern bank of Rocky River, near the junction of the latter with Deep river, at an elevation of less than 500 feet.

University of N. C. J. A. HOLMES.

MAGNETITE FROM ORANGE COUNTY.

This magnetite is found on the farm of —— Cheek, about three miles south of Chapel Hill. Pieces ranging up to ten or fifteen pounds in weight are found scattered over the field. One of these was analysed with the following result :

Magnetic iron oxide	96.03
Silica	3.02
Water	.52
Sulphur	.19
Phosphorus	trace.
	99.76

Chemical Laboratory, U. N. C. JOHN L. BORDEN.

ACTION OF GASOLINE ON COPPER.

W. H. Watson (Chem. News 42-190) has recorded the action of various oils on iron and copper. Thinking it of interest to add to the list the action of gasoline, some was drawn from the bottom chamber of the generator in a Springfield Gas Machine and examined for copper. The oil was 88° and had stood in the chamber about six months. It was deeply colored. One litre was carefully distilled down to 5—10 c. c. This was then saturated with nitric acid and evaporated to dryness, the temperature being finally raised high enough to charr and burn off most of the organic matter. Washing out the residue with nitric acid and water and testing for copper, gave no indications of copper, showing that the gasoline exerted extremely slight or no solvent action on copper.

Chemical Laboratory, U. N. C. F. P. Venable.

LIST OF SCIENTIFIC PERIODICALS
KEPT AT THE UNIVERSITY OF N. C. FOR REFERENCE.

American Chemical Journal.
American Chemical Society Journal.
American Journal of Science.
American Journal of Agricultural Science.
American Microscopical Journal.
American Naturalist.
Annalen der Chemie, (Liebig's).
Annals of Mathematics.
Astronomical Register.
Berichte der dentschen chemischen Gesellschaft.
Boston Journal of Science.
British Geological Magazine.
Bulletin of the Torrey Botanical Club.
Chemical News.
Chemical Review.
Electric Review.
Franklin Institute Journal.
London Chemical Society Journal.
Journal fur praktische Chemie.
Mathematical Magazine, Erie, Pa.
Mining Record.
Nature.
Observatory. The,
Popular Science Monthly.
Science.
Science Observer.
Zeitschrift fur Analytische Chemie.

CONSTITUTION.

NAME: This Society shall be known as the ELISHA MITCHELL SCIENTIFIC SOCIETY.

MEMBERS: There shall be three classes of members—Honorary, Regular and Associate.

HONORARY MEMBERS shall be elected by a three-fourths vote of the members present at the time of the annual election of officers. They shall be recommended to the Society by the Council. They shall not be required to contribute to the funds of the Society. They shall receive the publications of the Society.

REGULAR MEMBERS: These shall be nominated by at least three Regular Members, and must receive a three-fourths vote of the members present at the meetings appointed for election. They must have been connected with the University of North Carolina as students or instructors: or be residents of the State of North Carolina, interested in scientific pursuits and actively engaged in scientific work. They cannot at the time be undergraduates of any College or University. They shall pay the annual fee within three months after notification of their election. They shall receive copies of the publications of the Society. They shall have the privilege of voting at all the elections of the Society and hold any of its offices.

ASSOCIATE MEMBERS: To encourage taste for scientific work among the undergraduates, they may join the Society as Associate Members, on the nomination of three Regular Members. They shall pay the fee for Associate Members and receive the publications of the Society, and may attend the Society's meetings. They shall have no power of voting nor of holding office. They may become Regular Members after leaving the University by payment of the proper fee.

If a Regular or Associate Member shall have paid no fees for one year and three months, his name shall be stricken from the list of members; and he cannot be re-elected a member until his past dues are paid.

Any proposition to remove a member for other cause than the non-payment of dues must come from the Council. It shall be read at an ordinary Scientific Meeting and can only be voted on at an Election Meeting. The removal can only take place by a three-fourths vote of the members present at such meeting.

ELECTION OF OFFICERS: All officers of the Society shall hold office for one year and shall be voted for during the month of May. The Secretary shall prepare lists of offices, leaving blanks for names opposite President and Vice-President, and filling in the others with the nominations of the Council. These lists shall be sent to the members, to be filled and returned by them. Absent members may vote by proxy. Twenty votes must be cast in an election and a majority of the votes cast is sufficient to elect.

OFFICERS: The officers shall be a President, two Vice-Presidents, a Secretary and Treasurer, and an Executive Committee.

PRESIDENT: The President shall preside at the meetings of the Society. He shall be a member of the Council. He shall draw up an address for the members, to be delivered at the annual meeting, stating the year's progress of the Society, plans for its improvement, &c. He shall be a Regular Member and need not reside at the University. He shall be eligible for re-election after one year.

VICE-PRESIDENTS: Of the two Vice-Presidents, one shall be resident at the University to preside over the meetings in the absence of the President. Both shall be members of the Council. They shall be eligible for re-election after one year.

TREASURER: The Treasurer shall receive all money due the Society, and shall pay out such sums as may be ordered by the resident Vice-President. He shall keep an account of such receipts and disbursements, and shall make an annual report to the Society. His account shall be audited by the Executive Committee.

SECRETARY: The Secretary shall record the proceedings of the Society and conduct its correspondence. He shall reside at the University. The offices of Secretary and Treasurer shall be held by one person, who shall be eligible for immediate re-election.

EXECUTIVE COMMITTEE: This Committee shall consist of the resident Vice-President and three other members. The Committee shall see to the publication of the Journal; shall audit the Treasurer's accounts; and with the President, Vice-Presidents, Secretary and Treasurer, shall form the Council of the Society.

COUNCIL: At all meetings of the Council, four shall constitute a quorum. Special meetings of the Society may be called by the Council. Nominations for officers and Honorary Members are to be made by the Council.

MEETINGS: There shall be an annual meeting of the Society for election of officers. This meeting shall be held during the month of May, and two weeks' notice of it must be given by the Secretary.

There shall be two meetings for the election of members, one in

December and one in April. Members may also be elected at the annual meeting.

There shall be monthly Scientific meetings, at which times Scientific papers and contributions to the Journal shall be read and discussed, and lectures delivered on subjects of general interest for the benefit and improvement of Associate and other members; also reports on progress in the various branches of Science, and brief biographies of distinguished scientific men.

FEES: The annual fee for Regular Members shall be two dollars. The annual fee for Associate Members shall be fifty cents. Any member can become a Life Member by the payment of twenty-five dollars.

JOURNAL: The Journal shall be published before October. It shall contain original contributions from the members of the Society on Scientific subjects. These papers must have a scientific interest and be subject to the approval of the Executive Committee. There shall also be published a list of officers and members, together with the President's address and reports of other officers.

All other matters relating to Journal shall be left to the Executive Committee.

AMENDMENTS TO THE CONSTITUTION: This Constitution can be amended only by a two-third's vote of all members present at an election meeting.

ROLL OF MEMBERS.

LIFE MEMBERS.

Green, Rt. Rev. W. M.
Sewannee, Tenn.
Hardin, Wm. H.....Raleigh, N. C.
Hooper, Prof. J. DeBernier
Chapel Hill.
Hubbard, Dr. F. M.........Raleigh.
Manning, Hon. John..Chapel Hill.
Morrison, Rev. Dr. ....
Phillips, Dr. Chas.....Chapel Hill.

REGULAR MEMBERS.

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Chapel Hill.
Battle, Dr. K. P., Jr.,
Marine Hospital, Stapleton,
S. I., N. Y.
Battle, H. B..............Raleigh.
Battle, R. H..............Raleigh.
Battle, T. H..............Tarboro.
Barringer, Rufus .....Charlotte.
Bingham, Maj. Robert
Bingham's School.
Blake Prof. J. R.Davidson College.
Burgwyn, W. H. ......Henderson.
Cameron, J. D...........Asheville.
Cameron, Hon. P. C.....Hillsboro.
Carr, J. S.............. Durham.
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4 Winthrop Place, N. Y.
Deems, Dr. F. M.
4 Winthrop Place, N. Y.
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Hays, John W..............Oxford.
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West Point, N. Y.
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Withers, W. A..................
Wood, Dr. Thos. F....Wilmington.

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Baker, F. A.
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Bryan, J. A.
Butler, M.
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White, W. H.
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Wood, Julian

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