

**CHEMICAL ARTIFACTS:
THE MUSEUM OF EARLY PHILOSOPHICAL APPARATUS
AT TRANSYLVANIA UNIVERSITY**

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Introduction

In March, 1775, Colonel Richard Henderson purchased 20 million acres from the Cherokees in an unsettled region of the British colony of Virginia then known as "Kan-tuck-ee" and hired Daniel Boone to mark a permanent trail into this territory [1]. In May of the same year, the legislature that was assembled to organize a government for the new country voted to name it *Transylvania* (literally: across the woods), perhaps because the Romans had used this name to describe a region of eastern Europe that also lay beyond a great forest [2].

When news of this purchase reached the Virginia assembly, it was declared illegal because this body had reserved the right to extinguish Indian title to lands within its borders. Between 1775 and 1800, however, 150,000 people crossed through the Cumberland Gap and traveled down Boone's Wilderness Road into the region that the Virginia assembly eventually established as *Kentuckee county*.

One of the problems colonists faced was that of preserving their British cultural heritage. To do this, they turned to the schools [3]. This might explain why the Virginia assembly took time in May, 1780 — during a period when their highest priority was the threat of British invasion following the fall of Charleston — to charter the establishment of Transylvania Seminary, which would serve as a spearhead of learning in the wilderness [1]. Transylvania thereby became the 16th college in the United States and the first on the other side of the Allegheny Mountains.

In 1789, the school was moved to Lexington, the commercial center of the region, and on December 22nd, 1798, it was merged with the Kentucky Academy to form Transylvania University. At their first meeting, the board of trustees of the new university established several colleges, including a Medical Department staffed by Doctor Samuel Brown, Professor of Chemistry, Anatomy, and Surgery, and Doctor Frederick Ridgely, Professor *Materia Medica*, Midwifery, and Practice of Physics.

In 1799, Professor Brown was authorized to use \$500 to import books and other items for instruction in the Medical College. Another \$800 was allocated in 1805 for the purchase of apparatus for teaching natural philosophy, which included chemical apparatus and a

galvanic battery. The Board of Trustees, in a public announcement that fall, proudly proclaimed the arrival of this apparatus, as well as additions to the college library which now totaled some 1300 volumes.

In 1816, the trustees made an offer to Dr. Thomas Cooper to become the first professor of chemistry. The salary, however, was purposefully set so low that he would refuse the offer, which he did. In 1818, Professor Charles Caldwell arrived from the Medical School at the University of Pennsylvania. Two years later, Caldwell convinced the legislature to give him \$5000 for the purchase of books and apparatus for the Medical Department. At the same time, the city of Lexington loaned another \$6000 to the college for the same purpose and an additional \$2000 was raised from physicians throughout the South. In 1821, Caldwell went to Europe to purchase books and apparatus that formed the core of one of the finest medical libraries in the country. Caldwell wrote [4]:

... the time of my arrival in Paris was uncommonly and unexpectedly propitious to that purpose ... Toward the close of that catastrophe (the French Revolution) the libraries of many wealthy and literary persons ... had ultimately found their way onto the shelves of the booksellers. ... I was apprised of the ... very precious repositories ... and purchased, at reduced prices, no inconsiderable number of the choicest works of the fathers of medicine from Hippocrates down to the revival of letters — works which in no other way, and perhaps at no other time could have been collected so readily and certainly, and on terms so favorable. ... Hence the marked superiority of the Lexington Library, in those works, to any other ... in the whole United States.

In 1832, Doctor Robert Peter (see Figure 1) came to Lexington to help run The Kentucky Female Eclectic Institute. He soon became an adjunct professor at Transylvania and in 1838 was elected to the chair of chemistry at that institution. In 1839, he and Doctor James Bush spent most of the summer in London and Paris purchasing books and apparatus for instruction in the Medical Department. In his correspondence, Peter wrote [5]:

We have bought a great many fine books and a great deal of excellent apparatus and anatomical and other models. Transylvania will shine. No other institution in our part of the world will be able to compare with her in the means of instruction. In fact, I have seen none in Europe that is more completely prepared to teach *modern* medicine.

As a result of these purchases, in 1841 the Transylvania Medical Department was described as the "best endowed medical school in America" [1]. Between 1817 and 1859, 6456 students enrolled in the Medical Department at Transylvania and Doctor of Medicine degrees were conferred on 1881 of these students. Transylvania thereby provided the foundation for the practice of medicine throughout much of the South. The Medical College was closed in 1859 as a result of a combination of political, social and economic forces as students and faculty drifted to other institutions in cities that had grown larger than Lexington.

The third major source of apparatus in the museum at Transylvania was the purchase of the Philip S. Fall collection in 1857. Dr. Fall was the founder of the Eclectic Institute mentioned previously, for which the apparatus had originally been purchased.

The Collection

A significant fraction of the apparatus purchased for use in the Medical Department can still be found in the Museum of Early Philosophical Apparatus in Old Morrison Hall on the Transylvania University campus at 201 W. 3rd Street in Lexington. A few of Caldwell's purchases have survived, including a vacuum pump and an Atwood's Machine purchased from Pixii in Paris and a portable Sussure hygrometer. Most of the collection traces back to Doctor Peters' visit to Europe in 1839 and Doctor Fall's purchases for the Eclectic Institute.

The collection, as it now stands, is a tribute to the efforts of Professor Leland Brown, who died recently (August 30, 1989) at the age of 91. Brown (Figure 2) joined the faculty in 1932 as a professor of biology, was acting president from 1942 to 1945, and retired in 1965 as vice president for academic affairs. As early as 1910, part of the collection was stored in a museum, but the majority was either in use or stored in various departmental basements and storage shelves. The preservation of the collection became especially uncertain in 1933, when the museum was dismantled and stored in an attic.

Over a period of years, beginning in 1949, Professor Brown cleaned, assembled, and identified the apparatus — when possible — and prepared it for display in its permanent home. In 1959, a catalog describing the collection was published [6], copies of which can be obtained by contacting Professor Monroe Moosnick at Transylvania University or Carolyn Palmgreen, curator of the library special collection at Transylvania. A few items described in that catalog are missing: the Watkins and Hill balance, the blow pipe and double bellows, the camera lucida, the Daniell's hygrometer, the electro-magnetic machine, the pith-ball electrometer, the eolipile or Newton's engine, the goniometer, the Hope's apparatus for measuring the density of water at different temperatures, the Marcet's steam apparatus for showing the relationship between pressure and temperature, and the safety lamp developed by Davy. In spite of these losses, the collection is both extensive and in excellent condition.

Chemical Apparatus

The collection includes a variety of items of chemical interest, some of which are shown in Figures 3 and 4, which includes: (1) a balance purchased from Charles Chevalier, (2) a voltaic pile 23.5" tall and 3" wide that contains 58 separate metal disks, (3) a eudiometer designed by Robert Hare of the University of Pennsylvania, (4) a eudiometer designed by Volta, (5) a large (10-qt capacity) copper retort, (6) a small (1-qt capacity) copper retort, (7) 2 large, three-neck Woulfe bottles, 5.5-6.5" in diameter and 8.5-12" tall, (8) 3 small, two-neck Woulfe bottles, 3.5" in diameter and 6.5" tall, (9) 2 tubulated retorts, 3" wide, 4.25" tall, with a 13" spout, (10) 1 untubulated retort, 6" wide, 8" tall, with a 20" spout, (11) a

precipitation glass about 6" tall on a solid glass base that tapers from a 4" width at the mouth to 1.25" at the bottom, (12) a 1-pt capacity apothecaries' vessel calibrated with both 1 oz and 1/4 pt gradations, (13) a demonstration cylinder 2" wide and 10.5" tall with a ground surface at the top, (14) a 500 cm³ graduated cylinder with 5 cm³ gradations, (15) a 100 cm³ graduated cylinder with 1 cm³ gradations, (16) a 1000 cm³ gas collection bottle with 10 cm³ gradations, (17) 3 lime-glass 1-L volumetric flasks, one of which is calibrated at 1000 cm³, (18) 12 assorted bell jars, 4-8.5" diameter and 7-14" tall, (19) 3 receivers to be used with vacuum pumps, each equipped with two barometer tubes, and (20) two tapered flasks, 3" diameter and 6.5" tall that could be sealed by inserting a glass sphere into the narrow mouth.

One of the more intriguing items of chemical interest is an "Improved Scale of Chemical Equivalents" shown in Figure 5, which was constructed by Lewis C. Beck and Joseph Henry, 2nd edition, manufactured in Albany in 1828. This chemical equivalents scale contains the following inscription.

The Scale of Chemical Equivalents, the invention of which is due to Dr. Wollaston ... to facilitate the general study and practice of Chemistry. The present scale differs from the original one, in the assumption of Hydrogen, as ... unity ...

Under the heading "Mathematical Construction," the inscription goes on to state:

It will be observed that the slider of the scale is graduated into divisions and subdivisions continually ... in length, from 8 at the top to 330 near the bottom. These divisions correspond in relative lengths to the differences of the logarithms of the numbers placed opposite them.

It then goes into a protracted discussion of the mathematics of "logarithms" and notes that distance between any two numbers on the scale is equal to the distance between any other pair that give the same ratio. Under the heading "Chemical Explanation", the inscription states:

The application of the logametric scale to Chemistry is founded on the most important fact in this science; which is, *that all bodies whether simple or compound that enter into Chemical combination, always unite in weights or in multiples of weights that have the same constant ratio to each other.* And as these relative weights have the same effect in forming neutral compounds and in producing other chemical changes they are called chemical equivalents, and may be expressed in numbers referable to a common standard taken as unity*. (*These have also been called atomic weights, because philosophers have supposed that in all cases of chemical combination an union takes place between the ultimate atoms of bodies. This is the basis of the Atomic Theory.) On this scale the least combining quantity of hydrogen is taken as the unit; and as eight times as much oxygen by weight enters into combination with hydrogen to form the chemical compound water, oxygen will be expressed by 8, and water by 9. If, therefore, the slider be so placed

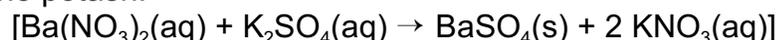
that 8 near the top of it coincides with the upper oxygen, the whole scale becomes a synoptical table of these chemical equivalents, having hydrogen as its radix. Thus 16 for the equivalent for Sulphur, 17 for Ammonia, 24 for Sodium, 70 for Barium, 110 for Silver, &c. &c. ... In order to diminish the length of the scale ... it commences with oxygen at 8, instead of hydrogen 1, and 10 atoms of hydrogen are placed opposite 10 on the slider. For the same reason, 2 carbon, the atomic weight of one atom of which is 6, is placed opposite 12. Again, as water and oxygen enter into combination in several definite proportions, 2 oxygen is placed opposite 16; 2 water opposite 18; 3 ox. opposite 24; 3 water opposite 27, &c. &c.

A series of "Examples and Illustrations" are then presented, into which a limited number of chemical formulas and equations have been inserted in parentheses.

1. Without moving the slider, the scale shows us that 50 is the equivalent number for carbonate of lime (CaCO_3); this substance consisting of carbonic acid (CO_2 not H_2CO_3) and lime (CaO), we find the equivalent of the former to be 22, and of the latter 28 = 50. Any denomination may be given these numbers, as ounces, grains, parts, &c. But if we wish to ascertain the constituents of any number of ounces, grains, or parts, as 100 for example, we have only to place 100 on the slider at carbonate of lime; and carbonic acid is then opposite 44, and lime 56; which are the proportions of these ingredients in 100.

2. Suppose we wish to ascertain the constituents of 100 parts of nitrate of ammonia. Move the slider so that 100 is at nitrate of ammonia, which we find has 1. *W.* before it, indicating one proportional of water. Then 1. water on the scale is opposite 11.3, on the slider; ammonia opposite to 21.2, and dry nitric acid to 67.5. The constituents of 100 parts of nitrate of ammonia are, therefore, 11.3, water; 21.2, ammonia; and 67.5 dry nitric acid, = 100.

3. When oxygen at the top is at 8 on the slider, sulphate of potash (K_2SO_4) is at 88, which is therefore its equivalent number. In order to decompose this, we may take nitrate of barytes [$\text{Ba}(\text{NO}_3)_2$], the barytes having a greater affinity for sulphuric acid, than the potash.



The quantity requisite for the decomposition is 132, being the number at nitrate of barytes; and the amount of sulphate of barytes resulting from this decomposition will be 118. We can also ascertain the quantity of nitrate of barytes necessary to decompose 50, 100, 150 or any other number of parts or grains of sulphate of potash, by placing either of the above numbers on the slider opposite to sulphate of potash and then finding the number of nitrate of barytes.

4. To find the composition of the metallic salts, we ascertain the amount of acid and *oxide* of the metal. Thus nitrate of silver (AgNO_3) is equivalent to 172, and consists of dry nitric acid, 54, and oxide of silver, 118, = 172. So also we find 100 parts of sulphate of barytes to consist of dry sulphuric acid, 34, and baryta or oxide of barium, 66. And in all cases where W is not prefixed to the salt it is then supposed to consist of a base united to a dry acid.

As might be expected, the scale gives good results for predictions that can be confirmed experimentally, such as the weight of BaSO_4 produced from given weights of $\text{Ba}(\text{NO}_3)_2$ and K_2SO_4 or the weight of AgNO_3 that can be produced from a given weight of Ag_2O . Faraday described the scale as follows [7].

There is a small instrument, the invention of Dr. Wollaston, which though not directly concerned in the actual performance of chemical operations, is of great and constant use in the laboratory, either in supplying the information requisite previous to an experiment, or afterwards in interpreting and extending its results ...

The scale only fails when applied to theoretical questions based on inaccurate or inappropriate theories. Within the limits of experimental error, for example, it correctly calculates the percent by weight of NH_3 in NH_4NO_3 . It errs, however, when nitric acid is assumed to contain one equivalent of water mixed with "dry nitric acid" and the percent by weight of water and dry nitric acid in ammonium nitrate is calculated.

Physics Apparatus

An impressive collection of apparatus can be found in the Transylvania Museum that was purchased to demonstrate the basic laws of physics. This apparatus can be divided into two categories: mechanical and electrical. Some of the items in the first category include: (1) an Archimedes screw, (2) an Atwood's machine, (3) a black glass or landscape mirror, (4) an apparatus for demonstrating collisions between bodies, (5) a set of equilibrium tubes to show that water will fill interconnecting tubes of any size or shape to the same level, (6) water and mercury fountains to be used with vacuum pumps, (7) a set of friction blocks, (8) glass models to demonstrate crystallographic forms, (9) a heat conduction apparatus, (10) three sets of heat reflectors, (11) a heliostat, (12) a hydrometric balance manufactured by Chevalier, (13) a hydrostatic paradox apparatus, (14) a set of Magdeburg spheres, (15) an Oersted's apparatus for measuring the compressibility of liquids, (16) a planetarium, (17) a planetary path model to demonstrate Kepler's laws, (18) a set of glass prisms on brass stands, (19) a variety of vacuum pumps manufactured by Chevalier, including one that stands over 5' tall and is 3' wide that was originally purchased by Dr. Fall for \$1070, (20) a horizontal pyrometer, (21) a sextant and a quadrant, (22) a 5'4" aperture, achromatic refracting telescope, (23) a thermoscope of Rumford or differential thermometer, (24) a Wedgewood's pyrometer and (25) an apparatus to show Newton's rings.

Electrical apparatus includes: (1) an aurora tube, (2) a condenser of Epinus, (3) several electric batteries consisting of sets of Leyden jars, (4) an cannon that could be fired with an electric spark, (5) several electric machines for generating static electricity, including one in excellent condition that uses a 33" diameter glass plate, (6) an electroscope, (7) several glass piercers that could be used to pierce a card with the discharge from a Leyden jar, (8) a Kinnersley thermometer to show the expansion of air when an electric spark is passed through it, (9) induction cylinders for storing electric charge, (10) a revolving armature engine, (11) a revolving bar magnet, (12) a sparking column and flyer for demonstrating the passage of an electric charge, (13) several thunder houses to

demonstrate the effect of lightening rods to protect buildings, (14) a series of electric discharge tubes with adjustable spark gaps that could be filled with different gases, (15) an electrophorus and (16) a Zamboni's apparatus purchased by Dr. Peter from Deleuil in 1839.

One item of physical apparatus of historical interest is a camera allegedly purchased by Dr. Peter during his visit to Paris in 1839, the year Daguerre introduced his photographic process. This camera has often been described as the source of the first Daguerreotype taken in Kentucky [8] and what may have been the first medical photograph [4]. Brown [6] rejects the notion that this is one of Daguerre's cameras and identifies it as a Fox-Talbot camera — or an early copy of one — similar to one on display in London dated 1835. The curator of the photographic archives in the special collection at the University of Kentucky has presented cogent arguments suggesting that the camera was not purchased in Paris in 1839, but constructed by or for Dr. Peter in Lexington [9].

Medical Apparatus

Wright has noted that the procurement of corpses for dissection was a challenge for medical students, who often turned to midnight expeditions to graveyards or commercial resurrectionists [1]. Thus, it is no surprise that a major fraction of the collection at Transylvania consists of models to teach materia medica, which includes: (1) a pair of artificial eyes to demonstrate near and far sightedness, (2) a life-sized wax model of an arm, the human head, and the colon, (3) plaster models of pathological conditions, (4) a set of foetal skeletons illustrating development month-by-month, (5) numerous plaster models of various organs mounted in wooden frames, and (6) papier-mache models of pregnant uteri. It also contains a set of 40 canvasses painted by A. Chazel in Paris of medicinal plants in the Jardin des Plantes in Paris, which were purchased by Dr. Peter in 1939. Because Peter's visit to Europe coincided with the publication of Schwann's cell theory, he included among his purchases a number of microscopes, including both aquatic (Raspail's) microscopes and cal-oxyhydrogen projection microscopes equipped with numerous slides of zoological and botanical specimens.

In his catalog, Brown [6] comments on the problems he encountered in identifying apparatus in the collection. One item he could not identify was described as follows:

Figure 87 represents a small ($9\frac{5}{8} \times 5 \times 4$ inches) well made box which is divided into eight compartments. In each velvet lined compartment there is a small belljar or receiver. These receivers are not all precisely of the same shape. Their brass tops appear to be made to fit into some receptacle. They have no obvious musical tones when struck.

Considering the reaction I receive whenever I mention that I had the privilege of spending a month as a Distinguished Professor at Transylvania University, it is intriguing that one of the few items that Brown could not identify was a set of blood-letting cups.

References

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- [5] Peter, R. *The History of the Medical Department of Transylvania University*. John P. Morton and Company: Louisville, KY, 1905.
- [6] Brown, L. A. *Early Philosophical Apparatus at Transylvania College (and Relics of the Medical Department)*. Transylvania College Press: Lexington, KY, 1959.
- [7] Faraday, M. *Chemical Manipulation; Being Instructions to Students in Chemistry on the Methods of Performing Experiments of Demonstration or of Research, with Accuracy and Success*. W. Philips: London, 1827.
- [8] Taft, R. *Photography and the American Scene*. New York, 1938.
- [9] Munoff, G. J. *The Kentucky Register*, Summer, 1980, p. 208-218

Figures

- [0] Potential cover photo: The first page of the receipt for purchases made by Dr. Charles Caldwell for Transylvania University from Pixii of Paris in 1821. Another potential cover photo is a photo of the planetarium on the front page of Brown's catalog.
- [1] Dr. Robert Peters, taken from *The History of the Medical Department of Transylvania University*. John P. Morton and Company: Louisville, KY, 1905.
- [2] Dr. Leland A. Brown, photograph obtained from Transylvania University.
- [3] Assorted glassware in the Museum of Early Philosophical Apparatus at Transylvania University. Photo taken by William Jensen.
- [4] Assorted bell jars and vacuum pump receivers. Photo taken by William Jensen.
- [5] A version of Wollaton's chemical equivalent scale manufactured by Beck and Henry in 1828.