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BULLETIN

April, 1938

of
THE COLLEGE OF WILLIAM AND MARY
IN VIRGINIA

EARLY TEACHING OF SCIENCE

at the

College of William and Mary
in Virginia

by

GALEN W. EWING

WILLIAMSBURG, VIRGINIA
1938

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EARLY TEACHING OF SCIENCE

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COLLEGE OF WILLIAM AND MARY IN VIRGINIA*

by GALEN W. EWING

THE first permanent English settlement in America, at Jamestown, Virginia, in 1607, was composed of men who came to the New World, not primarily to make new homes, not to escape persecution, but to make their fortunes through the gold and silver and other natural wealth which they had heard were to be found abundantly in this marvelous land. But when they arrived, they found no such fabulous bounty, and were forced to give all their attention and labor to maintaining themselves against the perils of famine and disease and unfriendly Indians. In spite of their numerous troubles and disasters, the Colony grew and prospered, until, by the end of the century, the settlement covered the entire tidewater area of Virginia.

As the Colony gradually increased in stability, the settlers were joined by immigrants of good family, culture, and education, and there developed a stratified society very much like that of London. The sons of the "First Families" were sent to the mother country for the completion of studies which had begun at the home firesides or in the parish rectory. Considering the difficulties of ocean travel and the expense which was impracticable for all but the most wealthy, it is not surprising to find the colonists repeatedly discussing the founding in the Colony of an institution of higher learning.

It was, indeed, only ten years after the first landing that, in 1617, a college had been planned for Henrico, near the present Richmond; but this soon fell a sacrifice to the great Indian massacre of 1622. The movement finally became successful, when, in 1693, a charter was granted by the King and Queen for an institution to be known as "The College of William and

*Reprinted with the kind permission of the publishers from the *Journal of Chemical Education*, Vol. 15, No. 1, January, 1938.

Mary in Virginia.” The purpose was stated in the charter: “Forasmuch as our well-beloved and faithful subjects, constituting the General Assembly of our Colony of Virginia, have had it in their minds . . . to make, found and establish a certain place of universal study, or perpetual College of Divinity, Philosophy, Languages, and other good Arts and Sciences. . .”

(Courtesy Herbert L. Ganter)

DR. WILLIAM SMALL
PROFESSOR OF NATURAL PHILOSOPHY AND MATHEMATICS,
COLLEGE OF WILLIAM AND MARY, 1758-1764

The plan of organization of the College was taken directly from the accepted practice in the English Universities, known as the Oxford Curriculum.” There were to be three schools: the Grammar School, which carried a student through the higher classics; the Philosophical School, where one professor was to

teach Moral Philosophy, including rhetoric, logic, and ethics, and another Natural Philosophy and Mathematics, including physics, metaphysics, and mathematics; and, thirdly, the Divinity School which was entirely post-graduate. Four years' study in the Philosophical School entitled a student to the degree of Bachelor of Arts, and seven years to that of Master of Arts.

The College of William and Mary first opened its doors in 1697 with only the Grammar School in operation. The first Philosophical chair established was that of Natural Philosophy and Mathematics in 1712. The others followed in due course.¹ This first professorship was held by some nine men up to the Revolution, each serving from one to twelve years. Only one of these was outstanding in his profession, Dr. William Small, who served from 1758 to 1764. Of the others, half were clergymen of the Church of England most of them possessing a good general education, but not specially fitted to teach science. The Rev. John Camm, for instance, held for a few years the chairs of Moral Philosophy and Natural Philosophy and Mathematics as well as his proper field of Divinity.

With the coming of Dr. Small, however, natural science came into its own. He was enthusiastic about his subject, and was a convincing teacher, as well as an ardent scientist. His influence was felt not only in the College, but in the court of Governor Fauquier, at whose table he was a frequent guest, and, indirectly, through the whole colony as well. Governor Fauquier was himself greatly interested in the sciences, and he and Small led discussions of all sorts among the youth of the city.

One of these young men on whom a great impression was made was Thomas Jefferson. There is no doubt that it was largely due to his stay at William and Mary under the tutelage of Dr. Small that Jefferson's ideas of the dignity of man rose and developed. Jefferson said of him that "he fixed the destinies

¹As the name of the great Robert Boyle is connected with the early progress of the College, it should be pointed out that this had no relation to the scientific activity either of the "sceptical chymist" or of the College. The executors of Boyle's will were directed to dispose of the bulk of his estate for whatever charitable or pious object they might see fit. They purchased therewith the Manor of Brafferton in Yorkshire, England, the income from which was to be used to propagate the Gospel among the infidel. Part of this was allotted to the College of William and Mary for the support of an Indian school. The College, in the year 1723, constructed a building for this purpose, which was called "The Brafferton" and still stands. In it eight to ten Indians were maintained until the Revolution cut off the income. The Brafferton was used as residence by Professors P. K. Rogers and W. B. Rogers, hereinafter mentioned.

of my life," and he undoubtedly meant by this that those free conceptions which animated his career were largely influenced by his associations with Dr. Small, who, as the professor of the

OLD APPARATUS IN THE POSSESSION OF THE COLLEGE OF WILLIAM AND MARY. WIMSHURST MACHINE, ELECTRO-STATIC BELLS, SPIRAL DISCHARGE TUBE, GUINEA AND FEATHER TUBE.*

natural sciences, was the enemy of all the narrow dogmatisms of the old philosophy.

Dr. Small's most lasting contribution was the innovation of

*The "Guineas" are coins stamped "R. Walker's Patent. No. 13½B4" and a crown. The only clue known to the writer as to the maker's identity is the fact that a Ralph Walker was apprenticed in 1747 to the well-known maker of telescopes, George Sterrop of St. Paul's Churchyard, London. It seems probable that this is one of the three extant pieces of apparatus purchased by William Small, though not appearing in the fragmentary list.

the modern lecture system in William and Mary, and, it is believed, in all America as well. This was a great departure from the system previously universally practiced, of pure memory lessons and recitations by questions and answers, which were either printed in textbooks or dictated by the professors. It

AN OLD HAND GENERATOR IN THE POSSESSION OF THE COLLEGE OF WILLIAM AND MARY. PROBABLY ONE OF THE THREE PIECES OF APPARATUS SAVED FROM THE FIRE OF 1859.

is interesting to note that the introduction of the lecture and demonstration method into the chemistry course at Harvard did not occur until the year 1851,² some ninety years after its introduction at William and Mary.

Dr. Small returned to England in 1764, where he became associated with James Watt, inventor of the steam engine, and with Erasmus Darwin, an eminent scientist, the grandfather of the author of "The Origin of Species." He was under a commission from the College to purchase a considerable collection of scientific apparatus. The College Library has preserved a folded sheet of paper in Dr. Small's handwriting, enumerating a part of this purchase. This partial list is given herewith.

"Brought forwards	£ 178-10-0
The Fountain Experiment in Vacuo &c. in open air with a Bason &c	3- 3-0
A Lung's Glass	10-6
The Barometer Expert	15-0

²Life and Letters of William Barton Rogers (*cf.* Bibliography), Vol. I, p. 192.

Wire Cage for breaking Glasses with 6 brass caps with Valves	1-11-6
Plates for Attraction & Cohesion	0-15-0
A Pendulum to Swing in Vacuo	2- 2-0
A Set of Glasses for the Air Pump	3-13-6
6 Pound of Quicksilver	1- 4-0
A Dipping Needle Compass 9 Inches Diam. with Needles for the Dip	15-15-0
A Horizon ¹ needle with a center Pin Works for it to stand on for the variation	0-18-0
	<hr/>
"Brought over	£ 208-17-6
a monichord	£ 208-17-6
A machine for the resistance of the Air according to Mr. Robinson	4- 4-0
A Standard Barometer	3-13-6
The 5 Platonic Bodies	2-12-6
A Cone dissected	1- 5-0
To Packing all the above	0-12-0
	2- 0-0

"Peter Dolland

The Acromatic Telescope with a Triple Object Glass $3\frac{1}{2}$ feet focus,	
two Eye Tubes for Astronomy & one for Day Objects	15-15-0
A best double microscope &c	7- 7-0
A Solar Microscope with Apparatus	5-10-0
The Reflecting mirror a true parallel Glass	
A 12 Inch Concave Mirror, a flat Mirror	4- 0-0
A 6 Inch Concave Mirror	15-0
5 Lenses of different Sorts in Frames	3-10-0
2 best Prisms	3- 0-0
A Water Prism	2- 5-0
A Set of small Prisms in a Case	1-11-6
Two Specula on a Frame to shew a number of Reflexions	1- 5-0
3 Parall: Glasses 2 Inch: Diam. for taking the Sun's Altitude in Mercury	0- 6-0
A Square Par: Glass 6 Inch: Diam. in a Frame	1- 1-0
An Object Glass for shewing the Rings of colors to be us'd with the Plane Glass	1-11-6
A Square Mahogany Tube with an Object Glass & a Number of Eye Glasses to shew the Direction of the Rays of Light in Eye Glasses	2-12-6
Packing the above	0- 5-0

"Edwd Nairne*

	<hr/>
	£ 273-19-0
An Electrical Machine	10-15-0
A Glass Jarr	2- 8-0
5 Glass Syphons	7-6
A model in Glass to show the manner of Intermitting & Reciprocating Springs	2-14-0
17 Capillary Tubes	6-6
2 Glass Models of Pumps	4- 4-0
2 Glass Parallel Plains	18-0
A Glass Jarr, for the Hydrostatic Balance, the Screw, wheel & Axle Compound & other Levers & Weights, Wedges & Weights, Pullies & Weights & ye 6th Mechanic Power, all fix on 2 Brass Pillars	20- 7-0
A Brass Circular Carriage	3- 8-0

*Edward Nairne was born in 1726 and died in 1806. He was one of the most outstanding manufacturers of scientific instruments of his time. The Royal Microscopical Society has a microscope by Nairne to which is ascribed the date 1745.

A Mahogany inclin'd Plane w th a Quadr ^t which sets to any angle w th	4-16-0
Scale & Nest of weights 164 oz Troy	4- 4-0
Dr. Barker's Mill ³	3-17-0
An Instrument to try the Force of falling Bodies	
	<hr/> £ 332- 4-0"

Note especially that the total is over £300 up to this point, and the total of the complete list may have been larger. It is not known with any degree of accuracy what this would amount to in today's equivalent money values, but certainly as much as \$3000, and perhaps considerably more. It is highly significant that the College was willing to invest such an amount in scientific equipment, and this formed what was, without doubt, the best collection of its sort in America.

An incident which goes to show the importance attached to science in these days was the conferring upon Benjamin Franklin of the degree, Master of Arts, in 1756, the only honorary degree given by the College prior to the Revolution. This degree was accompanied by a diploma which warmly testified to his merits "on account of marvellous Discoveries in Natural Philosophy conceived by him and published abroad throughout the entire republic of Letters"

The Revolutionary War was ruinous to the College. The buildings were occasionally used for quartering troops as Williamsburg was alternately held by British and American forces. It was only with difficulty that the library and scientific apparatus were preserved from harm. The exercises of the College were only nominal and the students few and far between. After the close of the war it was several years before the College could get back to normal. That it did so successfully was due to the devoted zeal and ability of its President, the Rev. James Madison, and Thomas Jefferson, who, as Governor of the Commonwealth and a Visitor of the College, had his residence in Williamsburg during the year 1779.

In this year, Jefferson presented a bill to the legislature, designed to change the organization of William and Mary into that of a university for the State. Although the bill was not enacted, considerable changes resulted from the close coöperation of Jefferson and President Madison. This reorganization was

³Barker's Mill is a device to produce rotary motion from water pressure by a series of reaction jets, similar to the familiar lawn sprinklers of today.

evidenced in particular in a new list of professorships and in the abandonment of the old Oxford curriculum in favor of the modern system of electives.

The Grammar and Divinity Schools were abolished. There were instituted a Professorship of Law and Police, one of Anatomy, Medicine and Chemistry, and one of Modern Languages. To the Professorship of Natural Philosophy and Mathematics was added Natural History, and to that of Moral Philosophy, the field of "Law of Nature and Nations" and Fine Arts.

(From C. L. Goodwin, *"The Colonial Church in Virginia."*
Courtesy Morehouse Publishing Company)

JAMES MADISON, D.D.
PRESIDENT OF THE COLLEGE OF WILLIAM AND MARY,
1777 TO 1812; FIRST BISHOP OF VIRGINIA

The policy of allowing students to elect their studies was here introduced for the first time, long before it was adopted by any other American college. President Madison wrote in a letter to President Stiles of Yale College, dated August 27, 1780, ". . . The Doors of ye University are open to all, nor is even a knowledge in ye ant. Languages a previous Requisite for Entrance. The Students have ye Liberty of attending whom they please, and in what order they please, or all ye diffr. Lectures in a term if they think proper. The time of taking Degrees was formerly ye same as in Cambridge, but now depends upon ye candidate. He has a certain course pointed out for his first Degree, and also for ye rest. When Master of Either, ye Degree is conferred."

The courses leading toward the several degrees were (in 1792) the following. For the degree of Bachelor of Arts, the student must be acquainted with the first, sixth, eleventh, and twelfth books of Euclid, plane trigonometry, surveying, algebra, spherics, conic sections; he must have acquired a knowledge of Natural Philosophy as far as it relates to the general properties of matter, mechanics, electricity, pneumatics, hydrostatics, optics, and the first principles of astronomy; he must be acquainted with logic, the belles lettres, rhetoric, natural law, laws of nations, and the general principles of politics; he must also have a competent knowledge of geography and of ancient and modern languages.

For a master's degree, the student must have an intimate acquaintance with science in general, or he must have distinguished himself for his researches in a particular science.

For the doctor's degree, the candidate must prove himself deeply versed in the science in which his degree is to be taken. (It is to be noted that the word "science" as here used refers to the whole fields of academic learning, and not specifically to what we call sciences, which were considered branches of philosophy.)

In 1795 there were thirty or forty students in philosophy and law, with the philosophers increasing more rapidly than the lawyers. The College possessed over three thousand volumes of selected works in its Library, and its philosophical apparatus remained the best on the continent.⁴

⁴According to a letter apparently written by St. George Tucker to Rev. Jedediah Morse in 1795 and quoted by Dr. Lyon G. Tyler in the *William and Mary Quarterly Magazine*, 1st ser., 2, p. 195.

Jefferson expressed his opinion of the College in the following complimentary terms. "What are the objects of an useful American Education? Classical knowledge, modern languages, chiefly French, Spanish and Italian; mathematics, natural philosophy, natural history, civil history, and ethics. In natural philosophy I mean to include chemistry and agriculture, and in natural history to include botany, as well as the other branches of those departments. It is true that the habit of speaking the modern languages cannot be so well acquired in America; but every other article can be as well acquired at William and Mary as at any place in Europe." This opinion is especially significant coming from Jefferson, himself a great educator, who was personally widely acquainted with academic circles of Europe and America.

The first science teacher after the Revolution was James Madison, who had come to the College in 1773. He became President in 1777, which position he held until his death in 1812. After the disestablishment of the English Church, he was made first Episcopal Bishop of Virginia. He was a member of the American Philosophical Society and contributed a number of original papers to its and other scientific journals. Like his predecessor, William Small, his first asset was an ability to deliver forceful and vitally interesting lectures. He was a great favorite among his students, one of whom wrote in 1804 in these glowing terms.

"The character of Bishop Madison is an interesting one. In his life and habits he is perfectly systematic and regular; in his disposition, placid and indulgent; in his manners, the perfect gentleman; and in point of scientific knowledge he is undoubtedly a finished scholar. As a tutor, he certainly stands in the first rank. He strives with indefatigable zeal to open and expand the mind of the student, and his manner of illustrating is plain, intelligible and convincing. In his opinions of every kind, he is liberal and indulgent. The priest is buried in the philosopher, for he embraces no opinion that philosophy will not justify. With a perfect knowledge of mankind, he is at once able to discover virtue and merit wherever they exist—qualities which he treats with respect in every condition of life, while their opposite vices meet with his invariable neglect and disapprobation."

Another student, in 1799, writes, “. . . But from all the other studies put together, I do not promise myself half the pleasure I receive from N. Philosophy. The Lectures on Magnetism and Central Forces were particularly pleasing to me for altho the theories of Magnetism are extremely chimerical, and indeed some of them absurd and ridiculous in my estimation, yet the phenomena are so curious, beautiful, and interesting that they are truly entertaining. But the doctrine of Central Forces, is not so obscured with any of these fanciful theories, here the laws are beautifully explained, and the phenomena satisfactorily accounted for. The Whirling Table is certainly one of the most beautiful machines that was ever invented for the illustration of Philosophical phenomena. Upon the whole I think these lectures far preferable to any yet delivered.”

The College Library has in its vault a notebook containing in its two hundred pages “A Compendium of Lectures as delivered by James Madison President of William and Mary,” taken from his lectures by “Robert D. Murchie William and Mary Virginia 1809.” It is probable that Murchie took rough notes during the lectures and recopied and reworded them afterward, for the whole work is remarkable for its neatness and order. Extensive quotations will not be out of place, as they give evidence as to the content of the Natural Philosophy course of the time and as to the Bishop’s remarkable personality as well.

The index of lectures is as follows: (the original is tabulated and includes page numbers) “Introductory; of matter or bodies in general; Chemical Affinity; Gravitation; Magnetism; Motion; Central forces or doctrine of circular motion; Of bodies falling perpendicularly; Of pendulums; Mechanical Powers; Compound Mechanics; Wheel carriages; Electricity; Of the two electricities; Of electricity communicated to electrics; Of the effects of electricity upon plants, vegetables, etc.; Galvanism; Pneumatics; Of the properties of air; Of air as necessary to combustion, etc.; Of heat; Introductory to airs; Of some of the gasses (*sic*) [oxygen, hydrogen, nitrogen]; Of Nitrous air [including also ‘Of the Carbonic acid, Of the analysis of atmospheric air’]; Of Evaporation; Of Winds; Of Hydrostatics; Of the densities and specific gravities of bodies; Of Hydraulics; On Optics, Light; Colours; Of the manner in which rays of light are refracted in passing through glasses of different forms; Of the senses in general; Of Microscopes and Telescopes.”

The following selections are quoted from the notes themselves.

“What is the design of natural philosophy? To become acquainted with the properties of natural bodies, investigate their causes, and thence to infer useful deductions. . . .”

WILLIAM BARTON ROGERS

PROFESSOR OF NATURAL PHILOSOPHY AND CHEMISTRY, COLLEGE
OF WILLIAM AND MARY, 1828-36. FOUNDER OF MASSACHUSETTS
INSTITUTE OF TECHNOLOGY

“What are the inducements to study natural philosophy? They are very great and very numerous, and drawn principally from five sources. 1st, Its extreme utility. 2nd, The gratification which the mind feels in pursuit of it. 3rd, The novelty and grandeur of the subject. 4th, It is the best field for exercising the

human intellects. 5th, It is the source of the sublimest conceptions of the author of the Universe. . . .

“That matter is infinitely divisible may be demonstrated mathematically; but when we come to apply this principle to actual experiment, we shall find that the powers of man have

BRONZE TABLET IN ROGERS HALL, COLLEGE OF
WILLIAM AND MARY

not arrived at that degree of perfection to be capable of carrying on the division to such an extent.

“General properties of matter are the following, Extension, Solidity,⁵ Inactivity (or vis inertiae), Divisibility, and Mobility; to

⁵*Solidity* is here used not in the modern sense in contrast to *fluidity*, but rather to indicate the fact that no two bodies can occupy the same space at the same time. An experiment is described “to prove the solidity of bodies apparently the least solid,” namely the trapping of air in a closed tube inverted over water.

which have been added, Configurability, Porosity, Rarefactibility, Condensibility, Compressibility, and Elasticity. . . .

"Some Chemists have supposed this force [chemical affinity], and the Newtonian attraction, on account of their analogy to be the same, and that the greater the gravity of any body, the greater also was its affinity. The cause of the latter is altogether unknown; however there is a remarkable difference observable in its laws and those of attraction. The latter acts between the largest masses, affinity takes place only between the smallest particles. Attraction operates at the greatest distances, affinity only in contact. Hence we see that if affinity be not entirely distinct from attraction, it can only be a modification of it.

AN OLD FRICTION MACHINE IN THE POSSESSION OF THE COLLEGE OF WILLIAM AND MARY. MADE BY E. S. RITCHIE, BOSTON. DIAMETER OF WHEEL, ABOUT THREE FEET.

“Do bodies really attract each other, or are they urged by an exterior force? Of this we are completely ignorant.

“The attraction of gravitation differs from that of cohesion or chemical attraction in this, that the latter may be destroyed, whereas the former is indestructible.

“The amusement which electricity affords us, is alone a sufficient inducement to study it. The cultivation of this science cannot fail to be particularly grateful to the inquisitive mind of man. Its peculiar advantage is, that it may be carried on as a recreation. I therefore advise every student to furnish himself with an electrical machine, and more especially, since the expense is small compared with the pleasure it will afford. He may then make discoveries of his own; and every one must be sensible that the satisfaction we feel from our own experiments is far superior to that which we derive from the discoveries of others.

“The manner in which the electric fluid is excited is a subject of curious speculation. As yet, it rests upon the uncertain foundation of conjecture.

“There seem to be three concentric strata of our incumbent atmosphere, in which, or between them are produced four kinds of --tions [word illegible], *viz.*, lightning, shooting stars, fire balls, and northern lights.

“It is necessary to make a few remarks on personal security during a thunder storm. . . . If you wish a place of perfect security place yourself in a feather bed suspended to the ceiling by silken cords. But this is a method which will be resorted to only by the guilty wretch who trembles at the thought of death and not by virtue’s ardent votary whose soul disdains the slavish fear of launching into the boundless ocean of eternity and supports him tranquil and unappalled amid the crush of worlds.

“The best definition of Galvanism seems to be, that it is the effect which small quantities of electricity produce, of convulsing the muscles and nerves of animals. Galvanism, it is true, embraces a variety of facts besides the above, but this definition should be adopted for the sake of distinctness.

“It is supposed, that there exists a very subtle and elastic fluid, dispersed throughout all the bodies of the universe, and capable of passing with more or less facility thro’ them all. This fluid has been called elementary heat [caloric]; it is one of the

principal agents the chemists employ in every process of decomposition, and in every enquiry by analysis.

"The atmosphere will dissolve a certain quantity of water. This is evident from its transparency. Take dry potash; weigh it in the dry state: you will find, in a short time, that it will have acquired weight: let it remain longer, and it will begin to run. Ice will lose part of its weight, when suspended in air, provided the temperature thereof is below the freezing point. Now in the first case, water was absorbed from the air: in the latter, it left the ice to combine with the air: in both the air was perfectly transparent: transparency is the test of solution: therefore the atmosphere will dissolve water. . . .

"How necessary a knowledge of the densities and specific gravities of bodies is, will best appear from attending to the following advantages which it affords. 1. It is necessary to determine the nature of fossils. 2. To determine what bodies are mineral and what are not. 3. To discover the purity of metals. 4. To discover genuine stones of value. 5. To determine the purity of liquors; which are mixed, and which are not.

"God said, let there be light, and there was light. But it is still a question what is light? Is it a mere quality of bodies, or is it itself a real body, a distinct species of matter? The more philosophers interrogate nature by judicious experiments, the more are they convinced that it is a real body. . . ."

He maintains throughout the old corpuscular theory of light in all its ingenious ramifications. The various colors are due to corpuscles of varying sizes: "Some colors are more agreeable to the eye than others, because they have less momentum, and of course do not irritate the retina of the eye so much." The caloric theory of heat is also dealt with at length.

There are numerous instances in these notes where it is quite apparent that demonstrations were performed by the lecturer. These include experiments in magnetism, the guinea and feather tube, electrostatic experiments using a friction machine, Torricellian vacuum, candle in a vacuum, reflection of heat, and the preparation of "nitrous air" from nitric acid and iron. He says, "There is a battery in the apparatus of William and Mary sufficiently strong to take away life."

The professorship of Anatomy, Medicine and Chemistry, established in Jefferson's reorganization, was held by a Dr. Mc-

Clurg, but after he left in 1800, two professorships of humanity were instituted by the Visitors in place of chemistry, much to the regret of President Madison, who included lectures on chemistry in his natural philosophy course. A separate chair in chemistry was not established until 1908, while anatomy and

INSULATED CONDUCTORS IN THE POSSESSION OF THE COLLEGE
OF WILLIAM AND MARY

medicine were never taught again as such. A class in botany was conducted as an extracurricular activity in 1806 by Dr. Girardin, Professor of Modern Languages, and later first president of the Maryland Academy of Science and Literature. A distinct chair of mathematics was established as early as 1784.

The next important scientist at William and Mary was Dr. Robert Hare in 1818, though this was but a minor incident in the career of that distinguished chemist. He was at William and Mary only one year, leaving to take the chair of chemistry at the University of Pennsylvania, where he remained for forty years. He was not a brilliant lecturer, but was famous for his demonstrations, in which he used many pieces of apparatus of his own development. He invented the oxy-hydrogen blowpipe, the hottest flame known at that time, before coming to William and Mary, and many other devices and processes subsequently.

He was succeeded by Patrick Kerr Rogers, M.D., who

served from 1819 until his death in 1828. Rogers was an interesting lecturer, performing numerous demonstrations partly with apparatus of his own construction.

Dr. Rogers published, in 1822, "An Introduction to the Mathematical Principles of Natural Philosophy." He was complimented highly upon this work by the aged Thomas Jefferson. In reply to Jefferson's letter, and referring to the newly established University of Virginia, Dr. Rogers says (March 14, 1824), "There is something in the organization of William and Mary which, independently of its location or other permanent disadvantages, must forever prevent it from being prosperous or successful; . . . I am inclined to think that when [the University] goes into operation we shall scarcely have oc-

WILLIAM AND MARY COLLEGE, WILLIAMSBURG, VIRGINIA

Center, the main college building constructed from plans drawn by Sir Christopher Wren; left the Brafferton, home of Professors P. K. Rogers and W. B. Rogers; right, the President's House. All are still in use. This picture is an original lithograph made by John Millington's son, Thomas, in 1840.

casation to open the doors of the old College. Even at present there is no reputation to be acquired here, and no encouragement to activity or zeal. . . ."

But in spite of its troubles, the College did continue to open its doors every year down to the present time, excepting only a short period after the Civil War. The faculty continued to do its best even in the face of an uncoöperative Board of Visitors whose indifference was the cause of our professor's pessimism.

Dr. Rogers, in the same letter to Jefferson quoted above, writes, “. . . Although we have a pretty large library in this place, we have very few books of real use to the profession, unless those on metaphysics, or what has been pompously denominated the philosophy of the mind, are to be considered as such. We have indeed the works of Bézout and Laplace, with several of the best treatises on chemistry, and the systems of natural and mechanical philosophy of Young and Robinson, which, after three years of solicitation, were reluctantly imported and received last summer. And of course we have access to most of the old writers on physics and mechanics, from Archimedes to Newton. . . .”

He favored Young and Robinson as the best English writers on mechanical philosophy. “Yet, I confess, I am not a convert to the theory of light and heat which is so ably defended by the former [Young]—the theory of undulations in a diffused universal medium. . . .”

The personal character of Dr. Rogers is presented in the following passages, quoted from Hon. A. H. H. Stuart, one of his former pupils and life long friend of his son and successor, William Barton Rogers.

OLD MOTOR OF DYMANO, ARMATURE LACKING. LABEL READS: “PRESENTED BY HON. JOHN TYLER, LATE PRESIDENT OF THE U. S. TO WILLIAM AND MARY COLLEGE”

“Dr. Patrick Rogers, at the time I became acquainted with him [1824], was about sixty or possibly sixty-five years of age, and a man of imposing presence. He was about six feet in height and was massively framed. . . . His hair was white as snow, and his complexion ruddy and healthful. . . . His manner was deliberate and dignified, but courteous and affable. In temperament, I judge, from the readiness with which his face would

flush with each emotion, that he was sensitive and excitable. He was devotedly attached to and proud of his sons, and on more than one occasion I was struck with the interest which he showed in the amusements of Robert [his fourth son, aged 11, a flyer of kites.]

"Dr. Rogers was a very learned man, and a most able, faithful instructor, and seemed desirous of keeping pace with the events of the day. As an illustration, I will refer to a single interesting incident. About the middle of the session, the newspapers of the State were teeming with accounts of the mysterious ringing of the bells in the elegant mansion of Colonel John Tayloe, of Mount Airy, in King George County. The bells would commence ringing violently all over the house without any visible human agency, or cause for so doing; and there was much speculation as to the true cause. In a few days thereafter, when the doors of Dr. Rogers' lecture room opened, the eyes of the students were greeted with the extraordinary spectacle of a whole system of bells in different parts of the room, ringing in concert, without any apparent cause for their activity. After we had looked for some time at the wonderful spectacle, they were suddenly and simultaneously silenced, and the professor then proceeded with a delightfully instructive lecture to show how the result had been accomplished, by currents of positive and negative electricity, thereby explaining all the phenomena connected with the Tayloe mansion on scientific principles. . . .

"Dr. Rogers . . . enjoyed the reputation of being a profound scholar, and I can bear testimony that he was a careful and faithful teacher, singularly successful in his illustrative experiments before his class."

The pessimism of Dr. P. K. Rogers, regarding the usefulness of the College, was largely nullified by his own son, William Barton Rogers, one of America's most eminent scientists, who succeeded to his father's chair at the latter's death in 1828, and maintained the high standards of the educational opportunities at William and Mary. In his address introducing his first course in Natural Philosophy, the new professor said,

"To your sensibilities I will commit the task of appreciating the feelings I experience when, with the affections of a cherished son and pupil, I view the objects that surround me, associated as they all are with the recollections of a venerated parent and

preceptor. Should I conduct you to the apartments in which for a series of years, with the calm dignity of true philosophy, he imparted to his pupils whatever is useful or sublime in physical science; should I display to your view the beautiful collection of philosophical instruments in which he took such pride, arranged with characteristic neatness and symmetry, and in some degree the products of his own ingenuity and zeal—you would feel these traces of his recent presence with a melancholy force, and friendship would sympathize with filial tenderness in the engrossing sorrow of the scene. . . .

“After these remarks, . . . I would solicit your attention to the views which I shall present in illustration of the *history*, *nature* and *utility* of Physical Science generally, and particularly that department of it usually denominated Natural Philosophy. In presenting these views, I propose—

“*First*. To allude to the relative proficiency of the ancient and modern worlds in Science and the Arts.

“*Secondly*. To exhibit some general ideas in relation to the material world; and,

“*Thirdly*. After defining the science of Natural Philosophy, and tracing the limits which separate it from Chemistry, to adduce a variety of illustrations to evince its utility. . . .”

Mr. Rogers met with immediate success. In his second year it is recorded that his classes were the largest in the College, and that the enrolment in the department of natural philosophy had not been equalled for the previous ten years. His class for that year is described by his brother Robert (age 16) writing to another brother, Henry.

“ . . . William has his hands full, having to lecture twice every day. His class are advancing very well indeed, and they are all very much pleased. William has divided his class into four divisions, which are called *clubs*; he meets one of them every night of the week except Saturday and Tuesday, and the students attend with the greatest alacrity possible. . . . I put my name down on the matriculation book, and made the 55th student. . . . William has made a number of fine models and is making many more, to explain conic sections, spherics and all solids. . . .”

Mr. William Rogers, also, was a matchless lecturer and demonstrator. He writes, “ . . . I have just concluded my lectures on caloric, to my own satisfaction, and, I am well assured, in a

manner agreeable to the class. No little difficulties arising from want of instruments, or from imperfection in those we possess, or any other trivial circumstances connected with my duties, give me the slightest uneasiness or perplexity. I employ every accessible means of illustrating my subject in an intelligible

DR. JOHN MILLINGTON

PROFESSOR OF NATURAL PHILOSOPHY AND CHEMISTRY,
COLLEGE OF WILLIAM AND MARY, 1836-1849

manner, and, when instruments fail me, I have recourse to explanations. The want of apparatus is certainly a serious difficulty in the way of a lecturer. But I believe that one course delivered under these circumstances is of more real value as an exercise to the professor than half a dozen assisted by the usual auxiliaries."

The College Catalog of 1829-30 gives as the content of the junior chemical course, "Inorganic and Organic Chemistry, the

application of Chemistry to the Arts of Bleaching, Dyeing, Tanning, Metallurgy, Brewing, Distillation, the manufacture of Glass and Porcelain, etc., together with the Elements of Botany and Mineralogy." The senior natural philosophy course embraced "Dynamics, Mechanics, Hydrodynamics, Pneumatics, Acoustics, Optics, Magnetism, Electricity, Meteorology, Physical Geography, etc., together with the practical subjects of the strength of Materials, the construction of Watch and Clock work, of Roofs, Arches, Bridges, Roads, the Steam Engine, and elementary principles of Architecture. . . . The studies in all the Scientific Departments are conducted by means of Lectures and Recitations, from appropriate text books."

William Barton Rogers made a lasting reputation for himself at William and Mary, at the University of Virginia, where he spent some seventeen years, in the whole State of Virginia for which he made a complete geological survey, and in the nation at large, for his brilliant geological discoveries (partly in collaboration with his brother, Henry Rogers) and especially in 1862 as founder of the Massachusetts Institute of Technology. He died in 1882 while delivering a commencement address at the Institute, aged seventy-seven years.

In 1905, the Massachusetts Institute of Technology established a scholarship, known as the William Barton Rogers Scholarship, to be awarded annually to a student of William and Mary College selected by its faculty. In 1927, the College of William and Mary dedicated its new \$300,000 hall of chemistry and

DR. JOHN MILLINGTON'S DESK

physics to this great alumnus, calling it the William Barton Rogers Memorial Hall. In the main hallway is mounted a bronze tablet whose appropriate sentiment was composed by the late President of Harvard University, Charles W. Eliot, who was professor of chemistry in Rogers' first faculty at M. I. T. This plaque is shown in the accompanying photograph.

Mr. Rogers was followed at William and Mary by Dr. John Millington who remained there thirteen years. He was already well known in London, having held appointments as Professor at the Royal Institution, being the friend of Faraday and Davy, Fellow of the Royal Society of Arts, Fellow of the Astronomical Society of London, Professor of Chemistry at Guy's Hospital, and Vice-President of the London Mechanics Institute. "At the age of fifty, as an engineer and teacher of science in his native London, he has approached greatness, though at a respectful distance."⁶ In 1830 he had been in Mexico as superintendent of a group of British mines and of a mint. A few years later he had conducted a shop in Philadelphia, supplying "all the various machines, instruments, apparatus and materials, required for mechanical, philosophical, mathematical, optical and chemical purposes."⁶ In 1835, he accepted the appointment at William and Mary.

He seems to have been successful as a teacher. In his first session at William and Mary thirty-seven students were enrolled in his class in chemistry and seven in the class in natural philosophy; but four years later, of the one hundred forty students matriculated in the College, seventy-four were taking chemistry and twenty-four natural philosophy.

He made for the College an extensive collection of geological and mineralogical specimens and materia medica. He also taught a course in surveying, a new subject at the College, for which he wrote a textbook, "Elements of Civil Engineering" (1839), of seven hundred sixteen pages.

In the chemistry stockroom of William and Mary at the present day is a small desk of ancient appearance, which bears in handwriting rendered scarcely legible by the years, the words "J. Millington 9-12-36[?]," inscribed on one of the drawers.

After the time of Millington, the science courses at William and Mary became more and more modern and contained little

⁶JOHNSON, T. C., JR., in the "Dictionary of American Biography."

of historic interest. Student laboratory training had its beginnings in the year 1855, when, according to the catalog, "Students wishing to study Analytical Chemistry are allowed the use of the Laboratory and Apparatus." No mention is made of general laboratory work until 1889.

In 1859 there was a disastrous fire which destroyed all but three pieces of the College's scientific apparatus. This was the

SIGNATURE OF JOHN MILLINGTON

end of much of the old equipment purchased a hundred years before by Dr. Small.

Thus William and Mary has had a history unique among educational institutions, being the first in America to introduce several highly important educational methods, notably the lecture method and the system of election of studies. Its undergraduate departments of science have been among the foremost in their fields from the earliest times even to the present day. Its great teachers of science of the past—Small, Madison, Hare, the two Rogers, and Millington—were generally recognized as among the outstanding men of their respective periods.

If the College has in recent years lost its unique position, it is not because its interest in the teaching of science has declined, but rather it is due to the fact that its ideals have become generally

recognized and put into practice in many institutions. But its members never forget that it was a pioneer, and they take great pride in that memory.

PROFESSORS OF SCIENCE AND OF MATHEMATICS AT THE
COLLEGE OF WILLIAM AND MARY IN VIRGINIA
PRIOR TO THE CIVIL WAR

(Dates shown are the years when professors were appointed; dates of resignation or death are given only when a hiatus occurs in the series.)

Professors of Natural Philosophy and Mathematics

— Le Fevre	1712-1713
Rev. Hugh Jones	1717
Alexander Irvine	1729
Joshua Fry	1732
John Graeme	1737
Rev. Richard Graham	1749
William Small	1758-1764
Rev. John Camm	1766
Rev. Thomas Gwatkin	1770-1775
Rev. James Madison	1773

Professor of Anatomy, Medicine, and Chemistry

James McClurg	1779
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Professors of Natural Philosophy

Rt. Rev. James Madison	1784
Dr. John McLean	1812
Dr. Thomas L. Jones	1814
Dr. Robert Hare	1818

Professors of Natural Philosophy and Chemistry

Patrick Kerr Rogers, M.D.	1819
William Barton Rogers	1828
Dr. John Millington	1836
William F. Hopkins	1849
Benjamin S. Ewell	1848

Professor of Mathematics

Rev. Robert Andrews	1784
George Blackburn	1805
Ferdinand S. Campbell	1811
Robert Saunders	1833
Benjamin S. Ewell	1848

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Every student of the history of the College of William and Mary must be greatly indebted to that indefatigable historian, the late President Lyon G. Tyler, who has recorded all sorts of source material, largely in the following publications:

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Tyler's Magazine, 1919 to 1936.

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Thanks are also due in very large measure to Dr. Earl G. Swem, Librarian of the College, who has indexed the above and other source material in his "Virginia Historical Index," 1935. Other material used in this paper include:

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