studies which to the experienced student are without promise. There are, however, speculative investments where the promise of large return is as great as the promise of a total loss. The investigator frequently finds himself facing a position of this sort. It is for him to say whether or not he will chance his time and energy on the study and if he decide affirmatively, those who give him financial support should back him without stint, for he has more to lose than mere money and what he gains is for the benefit of mankind.

You repeatedly entrust your health and lives to the judgment of the physicians and surgeons of this fine hospital. There should be no hesitation in entrusting the funds which you give to it, in expanding amounts, to the judgment of those who give their lives and energy to the research work within its walls. A great philosopher, René Descartes, said many years ago that "if ever the human race is raised to its highest practical level, intellectually, morally and physically, the science of medicine will perform that service."

The designer of the aeroplane gives little to humanity if his machine is to remain without fuel and there would be no practical benefit without the adventurous spirit which through pioneering in unexplored fields leads on to progress and to newer and broader visions. The plane is built, the laboratory completed. All honor to the designers and builders. The fuel is not merely the material means of operation, but it must volatilize as faith in the pilot and his crew, faith in their productive capacity, faith in their guiding genius. The pilot has many mechanisms to oversee. These should be as nearly perfect as the mind and hand of man can devise, so that the spirit shall not be hampered. The pilot is the directing intellect of the flight. Give freedom to his imagination and energy. The time will come when his wings are no longer rigid and he can fly freely in the skies of truth toward his ultimate objective, the welfare of man.

My congratulations to the trustees, the director and the staff of Mount Sinai Hospital. May they live long and may their work prosper.

HOWARD T. KARSNER
WESTERN RESERVE UNIVERSITY

COMMEMORATION OF THE BI-CENTENARY OF THE DEATH OF NEWTON[1]

THE fourth annual meeting of The History of Science Society was held in pursuance of an act of its council of last year, to commemorate the bi-centenary of the death of Sir Isaac Newton. In view of this unusual occasion, and of the manifold interests Newton had, it was therefore considered expedient to ask those societies most interested to cooperate by appointing representatives on the committee preparing the program. The following names are those who served:

COMMITTEE ON PROGRAM

Dr. R. C. Archibald, Brown University Dr. E. W. Brown, Yale University Dr. Florian Cajori, University of California	The American Mathematical Society and The Mathematical Association of America
Dr. A. O. Leuschner, University of California Dr. Frederick H. Seares, Mount Wilson Observatory	The American Astronomical Society
Dr. Leigh Page, Yale University	The American Physical Society
Dr. David Eugene Smith, Columbia University, Chairman Dr. Henry Crew, Northwestern University	The History of Science Society
Mr. Frederick E. Brasch, Library of Congress	Secretary to the Committee

The meeting was called to order by the president of The History of Science Society, Dr. David Eugene Smith, at 10 o'clock A. M., Friday, November 25, 1927, in the Educational Hall of the American Museum of Natural History, New York City.

The two days' program consisted entirely of papers on various phases of Sir Isaac Newton's contributions to astronomy, mathematics, physics, chemistry, religion, problems of the mint, and the development of science since his day, also some indication of Newton's influence on the early science in the American Colonies from 1687 to 1779. Two papers were devoted to each subject and these were given by scholars of distinction—from both the United States and Canada. Twelve papers reviewing Newton's work from the present historical standpoint made what is probably one of the most notable of single contributions to scientific literature. These addresses are to be published (by the History of Science Society) in a memorial volume.

The object of this American commemoration was twofold, first to honor the great name of Newton, and

[1] Report of the meeting and exhibition under the auspices of the History of Science Society, held at the American Museum of Natural History, New York, November 25 and 26, 1927.

second to acquaint the younger generation of students, as well as the public at large, with the contributions made in the various fields of knowledge in which Newton labored. From the standpoint of interest and attendance, the meeting was successful.

Old England may justly feel proud of the recognition America (United States) has accorded her greatest philosopher. Similar celebrations have taken place. Particularly we note the program given in Grantham, Newton's birthplace, on Saturday, March 20, 1927, the exact date of the bi-centenary of his death, which was attended by many of the greatest scholars of the British Empire, as well as by representatives from abroad. Both commemorations will go down in history and furnish most interesting recapitulations of Newton's influence in the history of science and civilization.

Following the abstracts of papers presented, a brief account of the exhibition is given. Dr. David Eugene Smith, chairman of the first morning's program, gave the introductory address. He spoke of the occasion of the Commemoration and of the life of Sir Isaac Newton. He said in part:

We come here to-day for two major purposes: First, to pay our respects to the memory of a man who is rated by the world as one of its greatest geniuses; and second, to weigh once more, by modern criticism if not by scales of precision, the world's claim that its judgment is just.

Of the esteem in which Newton's work has been held for two centuries there is no question. Few men have ever fared so well. The justness of that esteem has, however, been seriously questioned by various scholars of reputation. There have been assertions that his word was not "as good as his bond"; that his influence upon British mathematics was not salutary; that he abandoned the altar of science for the fleshpots of Egypt; that the foundations of his greatest mathematical theory were weak and the theory was unstable; and that he stands as a fetich for the unthinking worship of the Anglo-Saxon. Nor have there been lacking expressions to the effect that, had he been the great genius that England asserts, his countrymen would long since have given to the public a definitive edition of his complete works, his correspondence, and his papers. Such editions are a common tribute paid by nations or societies to the memory of their great men. Why should England have published the monumental editions of Cayley's and Sylvester's works and yet have so neglected Newton and have allowed the Portsmouth papers to lie practically in oblivion? Was there not back of all the praise, a feeling that the nation had risen to his defense in an inglorious dispute, but that at heart it doubted his greatness?

These questions have not been raised merely by men of no intellectual capacity who seek a place in the limelight by decrying the work of others; by those who, as a French philosopher has put it, rail at greatness because they can not achieve it. They come from honest-minded men who really wish to know what it was that Newton accomplished to make him worthy of the acclaim that has been accorded him; who ask for an answer, without excess of praise, to the justifiable question, "What were Newton's real contributions to world knowledge?" To give and to receive this answer is one of the purposes of our meeting. The answer, however, can not be given with authority by any one man or by any small group of workers in a single field; it can come only from several men, representing the various major fields in which Newton showed an interest. It is with this thought in mind that representatives from different learned societies have been requested to place before other scholars a series of succinct but authoritative statements of his achievements.

When we review his life, his idiosyncrasies, his periods of contrast, and his doubts and ambitions and desire for place, may we not take some pleasure in thinking of him as a man—a man like most other men save in one particular—he had genius—a greater touch of divinity than comes to the rest of us?

The questions to be answered by the speakers will relate chiefly to Newton as a scholar, and upon the answers will depend our judgment of the justice of the praise that has been given him. One thing will not fail to stand out clearly, however, that few men have ever lived who explored so successfully as wide a range of human activities, and few who could so justly have used the well-known phrase,

Homo sum, et nihil humani a me alienum puto.

The second address was by Dr. Dayton C. Miller, of the Case School of Applied Science, who spoke on "Newton and Optics."

This convocation is held to commemorate the bicentenary of the death of Sir Isaac Newton which occurred in London on March 20, 1727. We are not now just discovering Newton's greatness; in his own life time he was regarded as the greatest man in intellectual achievement which the world had known; the greatest possible posthumous honors were done him. . . . Voltaire, a contemporary, said of Newton: "If all the geniuses of the universe were assembled, he should lead the band." The appreciation of his greatness has continually increased during the two centuries that have elapsed since his death. . . .

In the year 1668, Newton made the first reflecting telescope, but he had not yet discovered the nature of the spectrum, for in 1669 he helped Dr. Barrow in the publication of Barrow's lectures on optics, in which an erroneous theory of color is set forth. . . .

In the autumn of 1671, Newton made a second reflecting telescope and the fame of his researches, especially in optics, began to spread. He was proposed as a candidate for admission to the Royal Society in December, 1671, and was asked to send the reflecting telescope to the society for inspection. The instrument was sent to London, and was exhibited before the Society on January 11, 1672, at which time a description of the telescope was read, and Newton was elected a fellow of the society. This telescope has ever since remained with the society as one of its most cherished possessions. Newton was very much pleased with the honor of election to the Royal Society, and his acknowledgment to the secretary, sent one week later, says:

I desire that in your next letter you will inform me for what time the society continue their weekly meetings; because, if they continue them for any time, I am purposing them to be considered of and examined on account of a philosophical discovery, which induced me to the making of the said telescope, and which I doubt not but will prove much more grateful than the communication of that instrument, being in my judgment the oddest if not the most considerable detection which hath hitherto been made into the operations of nature.

This promise was fulfilled by a communication which was read just one month later and the "considerable detection into the operations of nature" proved to be the complete explanation of the nature of the solar spectrum, and the true theory of color. . . .

Nothing more was done in the domain of optics, until, in 1704, Newton published the first edition of his book called "Optics; or a Treatise of the Reflections, Refractions, Inflections and Colours of Light." There were slight additions made in the second edition which appeared in 1718. For our present purpose, it seems desirable to give a description of the contents of this book, which covers all of Newton's work in optics, and to make a kind of inventory of the optical developments due directly to his work, as interpreted in the light of the third century following their origin. . . .

Rays of Light, by impinging on any refracting or reflecting Surface, excite vibrations in the refracting or reflecting Medium or Substance, and by exciting them agitate the solid parts of the refracting or reflecting Body, and by agitating them cause the Body to grow warm or hot; that the vibrations thus excited are propagated in the refracting or reflecting Medium or Substance, much after the manner that vibrations are propagated in the Air for causing Sound, and move faster than the Rays so as to overtake them; and that when any Ray is in that part of the vibration which conspires with its Motion, it easily breaks through a refracting Surface, but when it is in the contrary part of the vibration which impedes its motion, it is easily reflected; and, by consequence, that every Ray is successively disposed to be easily reflected, or easily transmitted, by every vibration which overtakes it. But whether this Hypothesis be true or false I do not here consider.

The returns of the disposition of any Ray to be reflected I will call its Fits of easy Reflexion, and those of its disposition to be transmitted its Fits of easy Transmission, and the space it passes between every return and the next return, the Internal of its Fits. (p. 256.) . . .

It has been very generally stated that Newton adopted and developed the corpuscular theory of light, in which light consists of small particles and nothing else. This interpretation was really thrust upon him by his successors, for he was always exceedingly careful not to commit himself to any specific theory of the structure of light. Thirty years before his treatise appeared, when he was actively engaged in the optical researches, and was sending reports to the Royal Society, he wrote to Hooke, saying: "Were I to propound an hypothesis it should be this, that light is something capable of exciting vibrations in the ether." Again he says: "The hypothesis of light being a body, had I propounded it, had a much greater affinity with the objector's own hypothesis (Hooke's Undulatory Theory) than he is aware of, the vibrations of the ether being as useful and necessary in this as in his." . . .

The science of light to-day is indebted to Newton not alone for his discoveries in optics, but in a greater degree to his general influence upon the methods of philosophic thought. The discovery of universal gravitation is the discovery of the law of universal order, which is the basis and essential character of all science. The example of such profound and comprehensive philosophizing has been one of Newton's contributions to optics as well as to other sciences.

And now, two hundred years after the death of Newton, we in behalf of the science of optics, wish to join the great chorus of all the sciences in doing reverence to him, not for what he was, but for what he has been for these centuries, and for what he is now. We repeat the inscription on the Westminster Tablet which was erected in 1731:

LET MEN REJOICE
THAT SO GREAT A GLORY OF THE HUMAN RACE
HAS APPEARED

The third address was on Newton's Philosophy of Gravitation with special reference to Modern Relativity Ideas, by Dr. G. D. Birkhoff, of Harvard University.

Up to the time of the ancient Greeks, scientifically-minded men had accumulated comparatively few experimental facts. For the description of these facts ordinary geometrical space and measurable time, which seemed self-evident, were available. Copernicus took the space attached to the sun to be at rest. On this basis Kepler deduced his three laws of planetary motion and was led to correct ideas about the forces of gravitation. Newton's greatest achievement lay in overcoming many mathematical difficulties and establishing the laws of gravitation and of motion known by his name. It was stated that Newton's scientific procedure was according to the best general principles. The reason for the recent progress to the relativistic theory of gravitation was found in the accumulation of evidence that the physical universe is basically electro-magnetic, rather than dynamical. Nevertheless the Newtonian dynamical theory of space, time and gravitation will always stand, as the first and simplest approximation to the facts.

The final paper on the morning program was by Dr. W. W. Campbell, president of the University of California, upon "Newton's Influence upon the Development of Astrophysics."

Astrophysics is concerned with what the stars, comets, nebulae and other celestial bodies really are, and why they are as they are. Spectrum analysis, the most remarkable, the most fruitful system of analysis in existence, rests upon Sir Isaac Newton's discovery that white light—sunlight, starlight—contains light of all known pure colors—really an infinite variety of colors. When starlight is passed through a telescope and a spectrograph attached thereto, the light records a message on the photographic plate—the star's spectrum—which describes precisely the conditions prevailing in that star. The finding of spectroscopic Rosetta stones, by Kirchhoff in 1859, and by his many successors in our physical laboratories, is enabling us to read the messages which many thousands of stars have sent to us and written down for us. These messages tell us what chemical elements and compounds, in the form of vapors and gases, are present in the outer strata of the stars, in comets, in the many kinds of nebulae. They tell us that our chemical elements are widely—perhaps universally—distributed throughout the universe. They tell us whether a given star is approaching us or receding from us and with what speed; that a certain star is a giant or a dwarf star and how far away it is; and a seemingly endless procession of facts relating to the conditions existing in the stars and other heavenly bodies.

The law of gravitation, discovered by Newton, is enabling us to learn much concerning conditions in the interiors of the stars, the comets and other objects.

Sir Isaac, with his own hands, constructed and used the first reflecting telescope, the forerunner of the giant reflecting telescopes of to-day.

Newton developed a preference for the corpuscular theory of light, as opposed to the undulatory or wave theory. To this end he may have been influenced by the difficulty of understanding why light radiations escaped paying toll for their transmission through space by wave motion. In the last year or two many physicists—notably de Broglie, Schroedinger and others—appear to be advocating a combination of the corpuscular and undulatory theories of light, as Newton himself very definitely did. Astrophysicists will be tremendously interested to learn the real nature of light, so that they may apply its principles to the solution of many of their most difficult problems, such as those of stellar evolution.

Sir Isaac Newton was uniquely the great pioneer in astrophysics.

Dr. E. W. Brown, of Yale University, presided at the afternoon program and introduced Dr. M. I. Pupin, of Columbia University, as the first speaker, whose remarks were upon "Newton's Dynamics."

The bi-centennial commemoration of Newton's death turns our thoughts to his great achievements, and the greatest of them is his science of dynamics. This achievement is the crown of the scientific endeavors of the two centuries which preceded Newton.

The most precious part of the Copernicus, Brahe and Kepler triumph was the great dynamical problem which was suggested, and which can be stated in the form of the question: Why do the planets move in accordance with Kepler's laws? This question was a hopeless puzzle to the science of the sixteenth century.

The problems of pendulum motions and of the motions of projectiles yielded to Galileo, but his dynamical science could not answer the question: Why do the planets move in accordance with Kepler's laws? Neither could the dynamical science of Galileo's successors who preceded Newton answer it.

The momentum concept was created by Newton, and it is the most fundamental concept in his dynamics. His second law of motion expresses this fundamental character of the momentum concept by making its time rate of variation equal to the moving force. This measure of the acting and reacting forces not only conformed with the results of Galileo's experiments but, moreover, it shed new light upon them which was not visible to Galileo nor to any of Newton's predecessors. It also agreed with all impact experiments, particularly with their revelation that during the impact of elastic bodies no momentum is lost.

The analysis of these impact experiments in the light of the second law was very helpful in the formulation of the third law, the law of equality of actions and reactions. Newton's third law employs a terminology the importance of which can not be overstated.

Astronomical evidence supported Newton's answer and this assured the world that a new science, the science of dynamics, was born, and that Newton, inspired by Galileo, was its father. To this new science Newton added his great invention of a new mathematical art, the art of the differential and integral calculus.

Dr. Paul R. Heyl, of the U. S. Bureau of Standards, spoke on "Newton as an Experimental Philosopher."

Newton from his earliest years took delight in constructing mechanical devices, and his innate skill of hand served him well in later years.

Newton is sometimes called "the king of thought" but he was far from being merely a speculative philosopher. His reasoned conclusions were carefully tested by experiment wherever possible.

Newton turned his acquired skill in the making of lenses to what was then the new art of grinding and polishing reflectors for telescopes. So skilful did he become in the construction of such reflectors that the best London opticians could not equal those of his production.

Newton's skill with his hands was in part innate, but we must recognize that his superiority over the professional opticians of his time was doubtless due to the same cause that contributed to the excellence of the work of a certain painter, who when asked the secret of how he mixed his colors replied: "With brains, sir!" Newton's knowledge of geometry guided his technique, and furnished suggestions which could not have been expected to occur to the mind of the artisan of those days.

In his "Principia" as well as in the "Opticks" there is to be found evidence of Newton's skill of hand and experimental ingenuity.

Even the members of the Royal Society, a body of men selected for their excellence in scientific knowledge and attainments and, as the minutes of their meetings show, assiduous experimenters, bore witness to Newton's experimental skill. And yet I think that Newton would have been rather surprised had he heard himself described as an "experimental" philosopher, and would have considered the expression tautological. The scientific specialization of our time was unknown to him. The term philosopher meant then what its etymology signifies—a lover of wisdom, and wisdom (it was beginning to be recognized) was to be found by questioning nature by experiment.

The next paper related to the historical "Developments Following from Newton's Work," in which Professor E. W. Brown traced briefly the work of two centuries in following out the consequences of Newton's laws as applied to the moon and planets. To predict the future position of a heavenly body we must know how it has moved in the past. Some 100,000 observations of the sun and moon alone have been utilized, and besides these many hundreds of thousands of observations of stars have been made to regulate the clock which is of equal importance with the telescope to secure the necessary information. These masses of observations are all bound together into one whole by Newton's laws of motion and of gravitation. The development of the consequences of the laws must be done by mathematical methods and some of the ablest mathematicians have devoted large portions of their lives to the work.

But the laws are not only applicable to the motions of the heavenly bodies, but also to all our terrestrial machinery. The structure of a skyscraper, the safety of a railway bridge, the motion of a motor car, the flight of an airplane, the navigation of a ship across the ocean, the measure of time itself, depend fundamentally on Newton's laws. Many failures of our mechanical devices, especially of those which move at high speed, may be traced to lack of knowledge or lack of care in applying those laws.

The essential characteristic of Newton's laws is their power to predict with certainty. It is a remarkable feat to be able to foretell successfully within a second of time a century hence the moment when the moon or a planet will be observed due south. In the ordinary routine of the astronomer it is regularly done, even more accurately, five years ahead, and the leeway necessary when the interval is extended is known. We have now arrived at the place where we have been able to measure the deviations from the laws themselves as well as the deviation from correct running of our time keeper, the earth, in its daily motion round its axis, but this would not have been possible without the most careful working out of the consequences of the laws. Much remains to be done in applying them to stellar systems, especially globular clusters and spiral nebulae.

The paper from Dr. Florian Cajori, of the University of California, was read by Dr. Lao G. Simons, of Hunter College, who spoke in part upon "Newton's Twenty Years' Delay in announcing the Law of Gravitation."

It is well known that Newton in 1665 or 1666 first tested the law of universal gravitation, but that he did not announce the law until 1686. Before the year 1887, it was universally accepted that Newton's delay of about twenty years in announcing this great law was due to his having used in 1665 or 1666 too small a value for the size of the earth, so that in applying his gravitational hypothesis to the earth's attraction for the moon, he obtained a theoretical result for the distance a body falls from rest on the surface of the earth in one second which did not agree with the experiment, and that he could not get the two results to agree until the Frenchman, J. Picard, supplied a more accurate geodetic determination for the size of the earth.

At the two hundredth anniversary of the publication of Newton's "Principia," in 1887, the astronomer, J. C. Adams, and the mathematician, J. W. L. Glaisher, advanced another explanation of the twenty years' delay. They stated that in 1666 fairly accurate values of the earth's radius were known and that the real cause of the delay was the question how a sphere attracts an outside particle. This question Newton did not clear up until sometime in 1685, and not until then did he consider valid his proof of the law of gravitation, as applied to the earth and moon.

It is the purpose of this paper to make a searching study of what was really known in England respecting the size of the earth, before Picard made his measurements, and to subject the entire question of Newton's delay to a critical examination.

The paper was divided into five parts, which were as follows: British views of the size of the earth before 1671; Newton's gravitational calculation of 1665 or 1666; Newton's apparent indifference during 1666–1685 to earth measurements; an essential step in proving the law of gravitation, and conclusion.

The first paper for the second morning program was by Dr. L. C. Newell, of Boston University, who also presided at this session, and spoke on "Newton's Work in Alchemy and Chemistry."

Throughout his career as an experimenter in alchemy, Newton was a philosopher searching for a clue to some great generalization concerning the nature and properties of matter.

Although he conducted many chemical and alchemical experiments continuously for about thirty-five years, from 1661 to 1696, in his laboratory beside the great gate of Trinity College in Cambridge, his chief purpose does not seem to have been transmutation of base metals into fine gold, but rather a diligent search for a great principle, which would transform disconnected chemical phenomena into a philosophic system. He was not an alchemist in the usual meaning of the term, with its unethical implications.

Newton's early interest in chemistry is indicated by items in a note-book which has been assigned to his preadolescent years, Professor Newell went on to say. Among the "strictly chemical" items, which the boy had written down, were directions "for making allum water," "How to make lime water," "How to melt mettle quickly yea in a shel," and a prophecy of what chemists of the future were to strive for seriously, "a color for faces."

Newton experimented assiduously in chemistry and alchemy in the many years he spent at Trinity College, Cambridge, as a student, fellow and professor.

Commenting upon Newton's idea of atoms, as set forth in his work on "Opticks," Professor Newell stated that Newton was not far from certain aspects of our modern views on the constitution of matter. Indeed, if this statement of atoms, and if many of the queries propounded in the "Opticks," were stripped of their trappings and rewritten in modern terms, I think we would be compelled to appraise Newton's views as closely approximating modern interpretations of the constitution and behavior of matter.

Dr. George S. Brett, of the department of philosophy, Toronto University, presented a paper on "Newton's Place in the History of Religious Thought."

Newton's relation to the history of religious thought is defined partly by the actual work which he did on passages and books of the Bible, partly by the general influence which he exerted on the thought of the eighteenth century. In this paper reference is made to the specifically theological writings, but more attention is paid to the effects which his ideas of law and order produced upon writers who were concerned to follow his example in reconciling science with religion. The mechanistic philosophy of the eighteenth century was largely due to the attempt of the Newtonians to restate the principles of religion in a way that reconciled them with the idea of a universal reign of law. This idea of law as opposed to the purely sentimental or pietistic view of religion is taken to be the most permanent effect of Newton's work and is held to be the aspect of the subject which most clearly persists to the present time. Though this influence is indirect and is due to the application of Newton's ideas rather than to his own statements, it is the most important aspect of his relation to the progress of thought on religious questions.

George E. Roberts, vice-president of The National City Bank of New York, and formerly director of the United States Mints in Washington, D. C., spoke upon "Newton in the Mint."

Newton's appointment in the mint was eminently fitting in every respect, but not without a political bearing. He had represented the University of Cambridge in the Parliament which established William and Mary on the throne, and Macaulay says that he was the glory of the Whig party. The immediate occasion, however, was the problem which confronted the government in dealing with the coins in circulation, which had been clipped and debased until the currency situation was intolerable. Macaulay's account of the government's inability to make new coins circulate while this old money was in circulation at the same legal tender value is the classic illustration of Gresham's law that "bad money will drive out good money."

Newton was invited to accept the position of warden of the mint in 1696. It was not the highest office in the institution, but he was made master of the mint three years later, and held that place until his death in 1727. He discharged his official duties with fidelity and energy, particularly during the great recoinage which lasted three years.

The recoinage, however, did not end the monetary problems. When the old silver coins were completely replaced it was found that the new coins were being exported because they were undervalued in comparison with the gold coins, and thus the government was confronted with the problem which vexed the world for the next two hundred years, to-wit, how to make the two metals circulate concurrently upon equal terms under free coinage for both. The government addressed a letter to Newton asking his advice. He replied that silver was sent out of the country because it was more highly valued in proportion to gold elsewhere, and suggested that the gold coins might be reduced in weight, but intimated that it was hardly worth while because the relative values probably would change again shortly. His letter was a model of clarity as far as it went, but became a subject of a controversy between the partisans of bimetalism and the gold standard which lasted until practically the entire world had adopted the gold standard. Both sides sought to use the authority of his great name, but he proposed nothing more than a tentative adjustment of values, for which there were precedents. Evidently he fully comprehended the economic laws governing the fluctuations of the two metals, but he did not discuss the fundamental difficulty involved in trying to maintain two standards of value at the same time, or say anything about the theory of alternative standards.

The last paper, relating to "John Winthrop (1714–1779), America's First Astronomer and the First Disciple of Sir Isaac Newton in the Colonies," was by Frederick E. Brasch, of the Library of Congress, Washington, D. C.

The history of science in the American colonies centered itself in the work of John Winthrop, Hollis professor of mathematics and natural philosophy at Harvard College from 1738 to 1779. Winthrop graduated from the famous Boston Latin School and entered Harvard College where he became the leading scholar of his class. He was appointed to the professorship at the early age of twenty-four years and almost immediately assumed the honor position as a scholar of great ability. His principal work was, however, in the field of astronomy and he made such notable observations upon sun-spots, transits of Mercury and Venus, that he was honored by election as fellow to the Royal Society of London. With the co-operation of the college authorities and the colonial governor he was able to embark upon the first astronomical expedition that this country has ever undertaken, which was in 1761. Winthrop's mathematical ability led him to the more advanced studies which were now to be found in the works of the great Newton, and he soon secured for himself a copy of the "Principia Mathematica," third edition, 1726. This was the second copy known to be in the colonies. Yale College secured the first, namely, the second edition of 1713. The work resulting from Winthrop's studies of the "Principia" now revealed the true character of our scholar, for he was the first to introduce the subject of fluxion (calculus) in the colleges about 1751, also the first to establish a laboratory of physics for experimental purposes in 1746. All Winthrop's subsequent work in astronomy was based upon the "Principia." He was somewhat of a seismologist, as well as having advanced the science of meteorology by his long series of recorded observations, also of the northern lights. During Winthrop's long period at Harvard College he was offered twice the presidency, but refused due to not too good health. He was honored, however, as no man of his time, as a scholar and scientist as well as an ardent patriot, for he espoused the cause of Washington, Adams and others, whose friendship and counsel was always sought. Winthrop was the first scholar to receive the honorary degree of LL.D. of Harvard College, which he also received from the University of Edinburgh. His contemporaries at home and in England recognized Winthrop as the first Newtonian scholar in the colonies. His equals may have been Halley, Bradley and one other in England. Winthrop died at the age of sixty-five years in 1779, and lies buried in the King's Chapel churchyard in Boston, along with his ancestors, the first governor of Massachusetts and the first governor of Connecticut.

The great exhibition of books, portrait prints, letters, autographed documents and medallic illustrations of Sir Isaac Newton, and of his mathematical contemporaries, which supplemented the addresses, were all arranged in suitable cases in three sides of the hall in which the audience gathered. This most imposing collection probably will never be duplicated at any one time and in itself constituted one of the richest contributions to that phase of the history of science which goes to make this subject interesting and fascinating. The labor and excellent arrangement of these beautiful memorials was carried out under the personal direction of Dr. David Eugene Smith. From Dr. Smith's private collection came 125 of the most exquisite and beautiful portrait prints of Newton, of various ages and painters; also 25 medals of about that many engravers and also the largest assortment of letters and autographed documents. Dr. Smith loaned also over 40 various editions of Newton's "Principia," "Opticks," "Fluxions," "Universal Arithmetics," as well as essays on Newton's life and work.

Besides the Newton material from this same private collection came portraits and autographed letters of Halley, Barrows, Cotes, Wren, Wallis, Huyghens, Cassini, all friends and coworkers of Newton. There were also exhibited portraits of Flamsted, Leibnitz, Descartes, Bernoullis, Wolf, Gauss, LaPlace, Gassendi, Pascal, Kepler, Galileo and Copernicus. Most interesting probably was a collection of letters from Leibnitz to Newton with notes in Newton's handwriting. This copy of bound letters was from Newton's private library. Another collection of letters to Newton came from four generations of astronomers royal of France, the Cassini family, to whom Newton was indebted for his data on the size of the earth. From the Babson Institute, Wellesley, came also a magnificent collection of 36 items representing the various editions of Newton's work, the most interesting and valuable being a copy of the first edition of the "Principia Mathematica," 1687, and the reissue of the same book. The first item contained notes and corrections in Newton's own handwriting. Copies of the 1713 edition of "Principia," edited by Cotes, with an enlarged chapter on the "Lunar Theory and of Comets," and the 1726 edition edited by Pemberton, the last published during Newton's lifetime. There was also a copy of Newton's "Opticks," 2nd edition, with notes in his handwriting. All these contained Newton's book-plate and autograph, showing they were from his private library. Besides a collection of portrait prints of Newton, a cast of the sun-dial as well as of his inscription cut on the window sill of the Grantham grammar school made by the boy Newton.

From Mr. George A. Plimpton's (New York) great collection of rare arithmetics came 12 items of Newtonian collected works, as well as single volumes. One item was Newton's copy of a journal with his signature and numerous notes.

Through the courtesy of Dr. A. Koegh, librarian of Yale University, were loaned two books by Newton which have more than passing interest. A copy of the "Principia," 1713 edition, and of the "Opticks," 1706 edition, were presented to the colonial college in New Haven in 1714 by Sir Isaac himself.

Through the courtesy of Dr. L. C. Newell, of Boston University, Dr. S. Brodetsky, Leeds University and Grantham Public Library, came an interesting collection of prints, pamphlets and newspapers giving an elaborate account of the Newton birthplace, of his boyhood and of the bicentenary celebration at Grantham on March 20, 1927.

Six interesting photostat copies of various leaves of a precious commonplace note-book of Newton when a boy of seventeen years were exhibited. The original note-book is in the Pierpont Morgan Library, New York.

Mr. James Stokley, of Science Service, exhibited a copy of Riccioli's Almagestum Novum which came from Newton's library with his annotations, and Dr. Florian Cajori, University of California, exhibited single special items bearing upon Newton's religious writings.

Following are the members of the committee on arrangements: Dr. Lao G. Simons, *Chairman*, Hunter College; Dr. Vera Sanford, The Lincoln School; Miss Frances M. Clark, Teachers College; Miss Helen Walker, Teachers College; Dr. Lester S. Hill, Hunter College, and Mr. John A. Swenson, Wadleigh High School.

FREDERICK E. BRASCH,
Secretary
LIBRARY OF CONGRESS,
WASHINGTON, D. C.

FRANK W. VERY

SUPPLEMENTING the excellent article by H. H. Clayton, in a recent number of SCIENCE, concerning the passing of Professor Frank W. Very, may I be permitted the privilege of adding the sincere tribute of one of his former pupils?

From 1885 until 1895 it was the great privilege of the writer to be associated with Professor Very in the class room and in the field. Every Saturday afternoon, it was Professor Very's delight, in company with a number of young people, to go forth seeking the hidden treasures of field and forest, mine and hill-side, railroad cuttings, and ancient river beds and terraces. With scientific nicety he followed the wonderful trail made by old Mother Nature, and even the most arrant tyro among us was inspired by the keenness of our leader's perception, and the wonderful deductions made by him in the simplest language. We collected fossils, water-worn stones, cocoons, flowers, mosses, lichens, ferns, insects—in fact everything of scientific interest we happened to come across.