GERARD MERCATOR:

HIS LIFE AND WORKS.

Read before the Society, by ELIAL F. HALL, Recording Secretary, April 16th, 1878.

MR. PRESIDENT, LADIES AND GENTLEMEN—Considerable attention has recently been given in France, Belgium, and Germany to the subject of the life and works of Gerard Mercator, the inventor of the projection for nautical charts which bears his name, and which is used, almost universally, by mariners. A biography of Mercator, in the French language, written by Dr. Van Raemdonck, of Saint Nicolas, in Belgium, was published there in the year 1869.* To this valuable work, I am specially indebted for the materials of the following sketch. I have also profited much by the perusal of an address in German, delivered by Dr. Breusing, of Bremen, at Duisburg, on the occasion of the three hundredth anniversary of the publication at that place of Mercator's nautical chart.† A spirited controversy has arisen between these two authorities upon the question whether Mercator was a Flemish Netherlander, or a German.‡ On the one hand, it is undisputed that he was born in the Netherlands, that his education was completed there, that he lived there during the earlier part of his career, that he was married there, and that all his children, six in number, were born there. But, on the other hand, it is equally undisputed that both his parents were

* Gérard Mercator. Sa Vie et ses Œuvres. Par le Dr. J. Van Raemdonck. St. Nicolas, chez E. Dalsechaert-Praet, Imprimeur-Libraire. 1869.

† Gerhard Kremer gen. Mercator, der deutsche Geograph, Vortrag von Dr. Breusing, Direktor der Steuermannsschule in Bremen, gehalten zu Duisburg am 30 März, 1869. Gedruckt bei F. H. Nieten in Duisburg. Selbftzerlag des Comités.

‡ See the pamphlet entitled "Gérard De Cremer ou Mercator, Géographe Flamand. Réponse à la Conference du Dr. Breusing, Directeur de l'Ecole de Navigation à Breme, tenue à Duisburg, le 30 Mars, 1869. Par le Dr. J. Van Raemdonck. St. Nicolas. 1870."

natives of Germany,* that he moved away from the Netherlands to Germany when he was about forty years of age, that he spent the rest of his life in that country, and published there his most important works. I refrain, however, from taking any part in this controversy, either on the one side or the other, or from entering further into its details. Our time is too limited, and aside from this, it is the character and achievements of Mercator—his contributions to the fund of human knowledge—rather than the accidents of his life, that press themselves, as it seems to me, more particularly upon our attention this evening.

The subject before us takes us back over a period of three hundred years, into the sixteenth century—the century that followed the discovery of the New World by Columbus, and the doubling of the Cape of Good Hope by Vasco da Gama—the century of Luther and the Protestant Reformation, and the rise of the Dutch Republic—the century of Charles the Fifth, Emperor of Germany, of Francis the First of France, and Henry the Eighth and Elizabeth of England.

Gerard Mercator† was born on the 5th of March, 1512, in a small town called Rupelmonde, situated in the Pays de Waes, in East Flanders, about eight miles above Antwerp, on the left bank of the river Scheldt, and opposite to its confluence with the river Rupel. Hence the name—Rupelmonde. He was the youngest of six children of a poor shoemaker. At the age of thirteen or fourteen he lost his father, and a few years later his mother died also. He had a great uncle, the uncle of his father, and named Gisbert Mercator. He was an ecclesiastic of the Romish Church, and chaplain to the Hospice of St. John at Rupelmonde. In this relative the lad Gerard found not only a faithful guardian, but a generous benefactor. To him he became indebted for the blessings and advantages of an education in the best schools of the Netherlands. He studied three

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* Van Raemdonck contends, that though the parents of Mercator were born in Germany, his grandfather and all his ancestors were originally from Rupelmonde, in Flanders.

† The word "Mercator" is a latinisation of the original name, which, according to Van Raemdonck, was "De Cremer," Cremer being the equivalent of the German "Kremer," or "Kraemer," and meaning tradesman or shopkeeper.

years and a half at the College of Bois-le-Duc in Brabant. Then, at the age of eighteen and a half, he entered the University of Louvain, which at that time was one of the most celebrated of the schools of learning in Europe. It had its five faculties, its forty-three colleges, and its five or six thousand students. Young Mercator was matriculated under the faculty of arts, which corresponded very nearly with the faculty of philosophy in a modern German university. From the old records, still preserved, it appears that he was enrolled in the list of indigent students. His great uncle, Gisbert, was not rich. He was dependent chiefly upon the revenues of his chaplaincy. From these he was able to eke out only a pittance for the expenses of his grand nephew. After the usual course of two years' study, young Mercator graduated with the degree of Master of Arts. He remained at Louvain, and made that his residence until his removal to Germany. At first he devoted himself to philosophical studies of such abstruse subjects as the origin, nature, and destination of the physical universe. He became absorbed in the great problems of science and revelation—the same which, under different forms and a different nomenclature, are agitating the minds and taxing the energies of many of the great thinkers and writers of the present day. He found it impossible to reconcile the Mosaic account of creation with the doctrines of Aristotle. Here he began to tread upon dangerous ground. In Louvain, as at Paris, the authority of Aristotle, in the domain of physical philosophy, was sacred and supreme. To dispute or question the perfect consistency and harmony of his teachings with those of the Church, was heresy. Pierre de la Ramèe, a French contemporary of Mercator, was tried for such heresy, and convicted, and his writings suppressed. Finding no one to sympathize with him in his doubts and misgivings, Mercator left Louvain, and secluded himself for study and reflection several months at Antwerp. We are not directly informed as to the results of this seclusion. He did not see fit to make them known to the public. But it may reasonably be inferred from his subsequent career, and from references made in the last years of his life to his early religious trials and experiences, that whatever skeptical views touching the divine inspiration and authority of the Scriptures may have been entertained by

him when he went to Antwerp, were effectually dispelled before he returned to Louvain.

As Mercator grew older, and as his mind began to take a more practical turn, he found himself confronted with another great problem, with which many, if not most of us, in these latter times, have also been obliged more or less to familiarize ourselves—I refer to the problem as to the best method of earning a livelihood. He soon saw that its solution would not be materially promoted by any further indulgence in philosophical speculations, and he accordingly abandoned them, or at least postponed them to a later period of his life. He chose for his vocation, the manufacture of mathematical instruments, and the drawing, engraving, and illuminating, or coloring of maps and charts. He took private lessons in mathematics with Gemma Frisius, an eminent professor in the University of Louvain, and a favorite of the Emperor Charles the Fifth. He made such rapid progress that he soon received permission from the Faculty of Arts to give private instruction, and thus he began to support himself. He established a workshop of his own, and here he manufactured astrolabes, astronomical rings, globes, and other like instruments, of such scientific accuracy and superior workmanship as to challenge the admiration of those who were interested in such articles. The products of his skill and industry found a ready market, and thus fortune seemed to smile upon him.

Mercator appears to have commenced his career as a chartographer by the publication of a map of Palestine, which made its appearance at Louvain in the year 1537. Increased interest in religious matters naturally led to an increased demand for such maps. No copy of this, his first experiment, has come down to us; but it seems to have been well received, as it was highly praised, by his contemporaries. His next work was a map of Flanders. It was undertaken at the solicitation of certain Flemish merchants. He travelled over the country, making surveys and measuring heights and distances. It took three years of time to complete the work, and it was published at Louvain in the year 1540. No copy of it is now extant; but it was undoubtedly far superior to any map of Flanders that had previously appeared.

A masterpiece of his handiwork, at this period of his life, was a large terrestrial globe, which he finished in 1541, and dedicated to

Granvelle, the Prime Minister of Charles the Fifth. It is now lost, but the original drawings for its exterior surface are still preserved at Brussels. With the aid of these drawings, a fac-simile of the original globe was constructed in 1875, and placed on exhibition at the Geographical Congress held that year at Paris. Granvelle rewarded Mercator liberally for the dedication, and recommended him and his work to the Emperor, from whom he accordingly received an order for a complete set of mathematical instruments. The Emperor was so much pleased with them, that he took them with him on all his expeditions, until they were finally destroyed by fire in Bavaria in 1546, in his campaign of that year against the Protestant Princes of Germany.

The year 1544 brings us to a remarkable incident in the life of Mercator—one which well illustrates the age in which he lived. He probably intended to keep himself aloof from the religious and political agitations of the times. But the fact is now established, though not discovered until a date comparatively recent, that he was once imprisoned as a heretic. The downfall at Münster in 1535, of the kingdom of the Anabaptists—the wild fury and frantic rage of these fanatics, and their licentious extravagances and excesses—produced a powerful reaction against the Reformation. At the head of this reaction, in the Netherlands, was the regent Mary, Queen Dowager of Hungary. She was a sister of the Emperor. Her husband, King Louis of Hungary, having lost his life on his flight from a battle in which he had been defeated by the Turks, her brother made her regent of the Netherlands. Those who have read Motley's "Rise of the Dutch Republic," will recollect the description which he gives of her in his first volume. He speaks of her as "a woman of masculine character, a great huntress before the Lord, a celebrated horsewoman, a worthy descendant of the Lady Mary of Burgundy."* She seems to have been much admired by Erasmus, the theologian of Rotterdam, who gave her the appelation of the "Christian Widow." She wrote to her brother, the Emperor, that "in her opinion, all heretics, whether repentant or not, should be prosecuted with such severity as that error might be at once extinguished, care being only taken that the provinces were

* Page 150.

not entirely depopulated." "With this humane limitation," says Motley,* "the Christian widow cheerfully set herself to superintend as foul and wholesale a system of murder as was ever organized. An imperial edict was issued at Brussels, condemning all heretics to death—repentant males to be executed with the sword, repentant females to be buried alive, the obstinate of both sexes to be burned." Under the operation of this edict, forty-three citizens of Louvain were accused of participation in what was called the "Lutheran heresy." It is not mentioned by Motley, but the fact is now beyond dispute, that Mercator was one of these forty-three. In February, 1544, he had occasion to visit Rupelmonde, his native place, on business connected with the settlement of the estate of his great uncle Gisbert. While there he was arrested and incarcerated in the fortress. None of his friends were allowed access to him, and his letters were intercepted and opened. He wrote back to Louvain, to his wife. She applied to the curate of her parish for his assistance. He gave her a testimonial in writing, in which he certified that her husband enjoyed a good reputation, led a religious and honorable life, and was not infected with heresy. This certificate was delivered to the Queen Regent. She evidently gave the case her special attention, as three or four of her letters relating to it are still preserved among the archives at Brussels. She reprimanded the curate for his temerity, in presuming to intercede for such a fugitive from justice as Mercator. She called him a fugitive, in consequence of his absence from Louvain at Rupelmonde at the time of his arrest. The curate, nothing daunted, fully explained to the Queen Regent the cause of Mercator's absence from his home, and solemnly protested that he had given the certificate conscientiously, and in strict accordance with all his information on the subject. He added that he would not have exculpated Mercator, if he had supposed that he was tainted with heresy, but on the contrary, he would have performed his professional obligations by trying to extirpate the evil. The curate then laid the case before the Abbot of St. Gertrude, who was specially charged with the duty of guarding the privileges of the University of Louvain against infringement. One of these privileges was the right of its members, when

* Page 80.

accused of any offence, to a trial exclusively before the tribunal of the Rector. The Abbot accordingly demanded the immediate release of Mercator from the sheriff or bailiff who held him in custody. The reclamation of the Abbot was forwarded to the Queen Regent, but she remained inflexible. She wrote to the Abbot, reminding him that in Mercator's case, all university privileges were forfeited when he fled from Louvain to Rupelmonde to escape arrest; and she threatened the Abbot that if he continued his interference, he should also be prosecuted. Finally, the Rector of the University came to the rescue, but, as it seems, in vain. He wrote to the Queen Regent a letter of remonstrance and expostulation. The only result appears to have been the institution of a formal inquiry for the purpose of determining whether Mercator was a fugitive from justice.

We have no information as to the cause or circumstances of Mercator's discharge from imprisonment. Whether he was tried and acquitted, or whether he was released through the intercession of influential friends, high in power and authority, is still a mystery. The record at Brussels closes abruptly with an epistle dated May 21st, and from this date the inference is drawn that Mercator must have been imprisoned nearly four months. This epistle is addressed to the Superior of the Franciscan Monastery at Malines, and he is urged to find a certain letter written by Mercator to one of the monks. At this date, therefore, the Queen Regent was still hunting eagerly for evidence of conviction. It is remarkable that Mercator never refers to his imprisonment in his writings. There is no evidence that he ever mentioned it to any one. Why he was so reticent upon a topic so interesting, is a matter of sheer conjecture. Perhaps he was bound by a pledge of secrecy as a condition of his release. Perhaps his forbearance was in furtherance of his purpose not to meddle with political or public affairs.

Mercator continued to reside at Louvain for seven or eight years after his release. He made a new set of mathematical instruments for the Emperor, to replace those which had been destroyed. He completed and dedicated to the Bishop of Liege a celestial globe of the same size and in the same style as the terrestrial one which he

had presented to Granvelle. A fac-simile of this also was exhibited at Paris in 1875.*

In 1552, Mercator removed with his family from Louvain to Duisburg, in the Duchy of Cleves, on the lower Rhine, in Germany. We have no certain or satisfactory information as to the cause or motive of this important change. Mercator himself never saw fit publicly to disclose it. Very likely his imprisonment left in his mind a sting of dissatisfaction and discontent. It seems that several of his friends abandoned the Netherlands about the same time and settled in Germany. Soon after his establishment in his new abode, Mercator completed for the Emperor an astronomical ring and a set of globes, elegantly equipped and ornamented. There was a celestial globe of glass or crystal. Upon it the constellations were engraved with a diamond. Inside of this there was a terrestrial globe of wood. Attached to this set were a compass, an hour circle, a quadrant of altitudes and other instruments. Mercator enjoyed the privilege of delivering these specimens of his skill personally to the Emperor at Brussels, and it was probably on this occasion that he was honored with the title of *Imperatoris domesticus*, or member of the Emperor's household. The astronomical ring was specially mentioned by Beausardt, an eminent professor at Louvain, in a treatise published by him on the subject of such rings, and in which he speaks of Mercator as confessedly the first of his age in the manufacture of such instruments. In 1554 Mercator published at Duisburg a large map of Europe. No single work of his contributed so much to his fame as a chartographer among his contemporaries,

* These globes are made the subject of a special treatise by Van Raemdonck, published in a pamphlet of seventy pages, at St. Nicolas, in 1875, and entitled: "Les Sphères Terrestre et Celeste de Gérard Mercator (1541 et 1551). Notice publiée à l'occasion de la reproduction de ces sphères à l'aide de fac-simile de leurs fuseaux originaux, gravé par Mercator, et conservé à la Bibliothèque Royale à Bruxelles. Par le Dr. J. Van Raemdonck." An atlas of wood-cuts of the exterior *fuseaux*, or "gores," of these globes, was published at Brussels, in 1875, entitled: "Sphère Terrestre et Sphère Celeste de Gérard Mercator, de Rupelmonde, editées à Louvain, en 1541 et 1551. Edition Nouvelle de 1875, d'après l'original appartenant à la Bibliothèque Royale de Belgique." Copies of this pamphlet and atlas have been presented to the American Geographical, Society, by the Comte d'Outremont.

as this. It is now lost, but we are able to judge of its merits through a reduced copy, published after his death by his son Rumold. When we compare it with those maps of Europe which preceded it, we readily appreciate the correctness of Lelewel's mention of Mercator, as the "veritable reformer of geography."* Important and radical changes and improvements are introduced in almost every part of Europe. The Mediterranean Sea is shortened by five degrees of longitude, and Cape Finisterre and the adjacent coast of Spain are removed fifteen degrees farther toward the east.

In 1564, Mercator published a map of Great Britain, which had been sent to him to be engraved by a friend in England. In the same year he published a map of Lorraine, based upon a trigonometric survey of the country undertaken by himself, for the Duke of Lorraine. The dangers and hardships of this task seriously impaired his health, and well nigh cost him his life.

In the year 1569, Mercator made his first appearance, after his removal to Duisburg, as the author of a printed book. It was a critica work on chronology, a folio volume of about four hundred and fifty pages, written in Latin, and published at Cologne. It was designed to supply the needs of the time. In these days we feel no such need; for with us, everything relating to the computation of time, has, comparatively speaking, become so well fixed and settled, that we give ourselves very little concern about it. But when Mercator lived, the human mind was recovering from the insensibility that paralyzed it in mediæval times. The condition of the European world at that period may be compared to that of a patient who is convalescing from a severe fit of sickness, lasting through weary weeks and months of delirium and unconsciousness. When he comes back to his senses he wants to know the time—what month and week, what day and hour it is. In order to be perfectly sure, he asks to look at the clock. It was somewhat so with the world, when it began to awaken from the lethargy of the dark ages. Grave errors were discovered in the old methods of computing time. The feeling prevailed, if I may so speak, that there was something wrong

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* "Par ses travaux, Gérard Mercator devint le véritable réformateur de la "géographie et donna l'impulsion à des réformes et aux progrès ulterieurs."—*Géographie du Moyen Age, étudiée par Joachim Lelewel, Tome* 2, *p.* 189.

about the almanac. Men of science, when Mercator's Chronology appeared, were engaged in the task of correcting and reforming the Julian Calendar, a task which was completed thirteen years afterwards, by the order of Pope Gregory the Thirteenth, requiring the fifth of October to be called the fifteenth of October. Mercator discusses at length, and with much learning, the subject of the dates of various events, particularly those of sacred history, and especially the birth and crucifixion of Christ. He treats of the various solar and lunar eclipses mentioned by historians, and endeavors to fix the precise time of their occurrence. He presents a catalogue of events, with their dates tabulated in columns, according to the different systems of the Assyrians, Persians, Greeks and Romans. This work appears to have been well received. Panvini of Verona, an authority on such subjects, was so much delighted with it that he made haste to seek the personal friendship of the author. But Jean Bodin, a French publicist of the time, criticised it with considerable severity. It failed to gain a permanent foothold as a contribution of lasting value to science or literature.* It was a compilation rather than a creation. It was the result of four years of careful, thorough and conscientious study and research, but it was not a production of original genius. It was quite otherwise, however, with another work of Mercator, which was published in the same year—the year 1569. I refer to his nautical chart, laid out upon a new projection, invented by himself. It was this that transmitted his name, and made it familiar to succeeding generations. But I omit further mention of it for the present. We shall come back to it, after we have followed Mercator to the close of his career.

Mercator was an admirer of Claudius Ptolemy, of Alexandria, and an enthusiastic student of his works. I do not mean by this that he followed him implicitly ; on the contrary, his map of Europe and other works furnished ample proof of his independence of Ptolemy, and his occasional dissent from his teachings. But Ptolemy's eight books on geography had ranked as the highest authority

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* " Das Werk wurde bei seinem Erscheinen mit so grossem Beifall auf-
" genommen, dass es bald darauf in Basel nachgedruckt wurde, darf aber auf
" bleibenden Werth keinen Anspruch machen."—Breusing, *pages* 27–28.

for more than twelve hundred years. Even after the discoveries of the 15th and 16th centuries, and in the lifetime of Mercator, they were still regarded as the groundwork of all geographical knowledge. In 1578, Mercator gave to the public a corrected and revised edition of the maps or charts of Agathodaemon, which accompanied the work of Ptolemy. They were twenty-seven in number, and were engraved on copper. Six years later, in 1584, he republished this collection, together with the entire text of Ptolemy's eight books, which he had also carefully and thoroughly revised and corrected. In this work of revision, he abstained from changing the text, so as to conform it to new discoveries or modern ideas; on the contrary, his object, as explained in his preface, was to purge it of the numerous interpolations, alterations and corruptions of all kinds which had crept into it, and thus to restore it as nearly as possible to the original, as it came from the hands of Ptolemy. And he specifies the various editions, five in number, which he had carefully compared and collated in carrying out his plan of restoration. This work of Mercator added greatly to his reputation as a geographer and scholar. It went through two editions after his death. Modern authorities continue to speak of it in terms of flattering commendation. The collection of Ptolemaic charts is pronounced the best in existence, both by Michaud in his *Biographie Universelle*, published at Paris in 1821, and by Breusing in his address already mentioned.*

We now come to the work of Mercator which is commonly known as his Atlas of Modern Geography. Our present use of the word "atlas" originated with this work, as I shall presently endeavor to show. Mercator devoted to it the last years of his life, and at the time of his death, in December, 1594, it was far from completion. Three parts, or numbers, were published separately, but not in the logical order in which the author intended that they should be arranged when bound together. He explains the reason of this, but it is hardly necessary to repeat his explanation. Part second was

* "Was er mit diesem Werke geleistet, mag Ihnen die Thatsache beweisen, "dass bis zu diesem Augenblicke keine mit Karten ausgestattete Ausgabe des "Ptolemäus erchienen ist, die nicht entweder die Mercatorschen Kupfertafeln "im Originale oder einen Nachstich davon gegeben hätte. So kann man "sagen, dass sie bis heute nicht übertroffen sind"—*Pages* 28–29.

published first. It appeared at Duisburg, in 1585. It comprised fifty-one maps of France, Germany and the Netherlands, accompanied by elaborate descriptive letter-press, in Latin, covering much the same ground as in our modern atlases. Part third appeared next, in 1590, and comprised twenty-three maps of Italy, Sclavonia and Greece. Up to this point, we have no intimation from Mercator of an intention to prefix the word "atlas" as a title to any of his works. But the modern application of this word to a collection of maps or charts is ordinarily ascribed to him. This ascription is substantially correct. It is certain that his modern maps were the first collection to which the name "atlas" was applied. But it is equally true that no work of his bearing such an appellation was published in his lifetime. About four months after his death, however, his son Rumold published a collection of maps of Northern Europe, designed by his father to be the first in order in the series, of which parts two and three appeared, as I have stated, in 1585 and 1590. Upon the frontispiece or title-page of this publication were inscribed the following words: "*Atlas sive cosmographicæ Meditationes de fabrica mundi et fabricati figura.*" Translated rather freely, they would read nearly as follows: "*Atlas, or cosmographical meditations upon the creation of the universe, and the universe as created.*" Rumold Mercator, in his dedicatory epistle, states that his father had adopted this title. This statement was doubtless true. It is confirmed by the contents of two pages of the introductory letter-press, purporting to be from the pen of the father. The first of these pages contains a genealogical tree of the ancestors and descendants of Atlas of the Greek mythology, who, as a punishment for leading the Titans in their war against Jupiter, was condemned to bear the heavens upon his shoulders. The other page contains an elaborate account of the members of the family of Atlas. The writer appears to take a rationalistic view of the subject. He speaks of one of the family as remarkable for his erudition, humanity and wisdom, and he adds that he proposes to imitate him in his philosophical studies and researches after truth. From this, it is obvious that Mercator, in his old age, beset with the infirmities and the whims and fancies of four-score years, and somewhat infected with the mysticism of the period, became quite infatuated with the ancient Greek fable. And the transition, I submit, was

natural and easy, from this state of mind, to the purpose to place the word "Atlas" upon the title-page of the work with which he was then occupied. At this point, the question arises, what was this work, or what did Mercator intend it should be? My answer is, that he probably intended that it should consist of a series of several volumes, and that the collection of maps left uncompleted by him should form only a single volume of the entire series, as thus contemplated. This view harmonizes with the peculiar phraseology of the explanatory alternative which follows the word "Atlas" on the title-page published by his son Rumold. What did the author mean by the words: "Cosmographical meditations upon creation and the universe?" Certainly, something more than a treatise on geography. They are too broad and comprehensive for a title to such a treatise. This view is further corroborated by what we know of the career of Mercator, and of his plans and aspirations. He was always ambitious of a higher distinction than that of a successful and celebrated publisher of maps and globes. The Duke of Cleves had conferred upon him the dignity of "cosmographer," prior to the appearance of his Chronology in 1569. In this and all his subsequent works, his name as author appears in connection with this title. In addition to the honor, there was a considerable pension attached to it, which was, doubtless, very acceptable. "But why," thought Mercator, "should not a cosmographer write a work on cosmography?" To us these words, "cosmography," "cosmographer" and "cosmographical," sound rather strange. They seem to have become nearly obsolete. They find no place in the most recent cyclopedias; but in an earlier cyclopedia,* cosmography is defined as the science "which treats of the construction, figure, disposition and relation of all the parts of the world, and as thus comprehending astronomy, geography and geology." In the preface to his Chronology, Mercator announced his purpose to publish a series of volumes upon cosmography and kindred sciences, including cosmogony, ethnography and history. He seems to have regarded his Chronology as the first of this series. Sixteen years later, in 1585, in the dedicatory epistle to the maps of France, Germany and the Netherlands, published that year, he recurs to the same subject, and

* Rees's Cyclopedia.

announces substantially the same purpose. When viewed in the light of these facts, we may readily conclude what Mercator meant by the terms "Cosmographical Meditations upon Creation and the Universe," which appear as an explanation of the word "Atlas," upon the title-page published by his son Rumold, soon after his death. "Atlas" was the name chosen by him for a treatise, as intended, of several volumes, descriptive of the material universe—a vast encyclopedia of the sciences, of which his maps of modern geography, with the accompanying text, was to form only a single part. In 1570, Abraham Ortelius, a contemporary and rival of Mercator, published at Antwerp a volume of maps, which he entitled "Theatrum Orbis Terrarum," or, "Theatre of the Orb of the Earth." A few years later, there appeared at Antwerp a similar volume entitled "Speculum Mundi," or, "Mirror of the World." Alexander Von Humboldt adopted the Greek word "Kosmos" as the title to the crowning work of his life. So Mercator adopted the Greek word "Atlas" as the title to the work which he planned and projected as the crowning work of his life. He did not mean to call it *an* Atlas, or *the* Atlas, but simply "Atlas." He never intended to give to it the generic sense in which it is now employed, as applicable to any and every collection of maps. With the revival, however, of geographical learning, there was great need of a term to denote such a collection. But there was no word in the classical or in the modern European languages that had ever done such service. We have seen how Rumold Mercator prefixed to certain maps the title "Atlas," which was designed by his father for a work of much larger scope. In process of time other chartographers borrowed this title and applied it to their own productions. Thus it was with Blaev's Atlas, De Wit's Atlas, and Sanson's Atlas. In this way the term gradually lost its special and particular application, until it came to import simply a collection of maps, in the general sense in which it is now used.

To the maps of Northern Europe, published after the death of Mercator, by his son, there was added a biography of him, in Latin, to which we are indebted for the most that is now known of his career. It was written by Walter Ghymm, an opulent burgher of Duisburg, a neighbor of Mercator, and his admirer and friend. There was also added an essay of about thirty folio pages, on the

Creation as narrated in the first chapters of Genesis.* Rumold Mercator, the only surviving son of his father, died in the year 1600. In 1602, the maps which, as we have seen, had appeared in three parts or numbers successively in 1585, 1590 and 1595, were united and published in a single volume, at the expense of Mercator's estate. This was really the first edition of his Atlas. Soon after this, the engraved copper plates of his maps and charts were purchased by an Amsterdam publisher, named Hond or Hondius. He brought out a second edition of Atlas in 1606, enlarged by the addition of fifty maps of Spain, Asia, Africa and America, which till then had been wanting. In a period of seventy-five years, Hondius and his successors at Amsterdam published no less than fifty editions of Mercator's Atlas in various languages. Two of these editions, both in French, are in the library of our Society. One, in a single volume, was printed in 1619, and the other, in two volumes, in 1633. The latter was presented to the Society by one of our Vice-Presidents, Mr. Francis A. Stout.

The fame of Mercator rests chiefly upon his achievements in the department of mathematical geography and chartography. He is known to us, principally, as the inventor of the projection which bears his name. A projection, I believe, is the representation of a geometrical magnitude on a plane or flat surface. But it is mathematically impossible to make a perfect representation of a sphere upon such a surface. There will always be a distortion of some kind; and the great problem is, to find a projection that will reduce this distortion to the least possible figure. This branch of science may appear rather dry and uninviting, but it is nevertheless fundamental and quite indispensable.† Mercator seems to have had a passion for it. At all events, he studied it with unremitting zeal. But I shall only mention two or three projections with which he had to do. He was the author of an important modification in the purely conical projection of Ptolemy. It was adopted and used by the French astronomer De l'Isle, in his large map of Russia, published in 1745. It is an interesting fact that the scientific world,

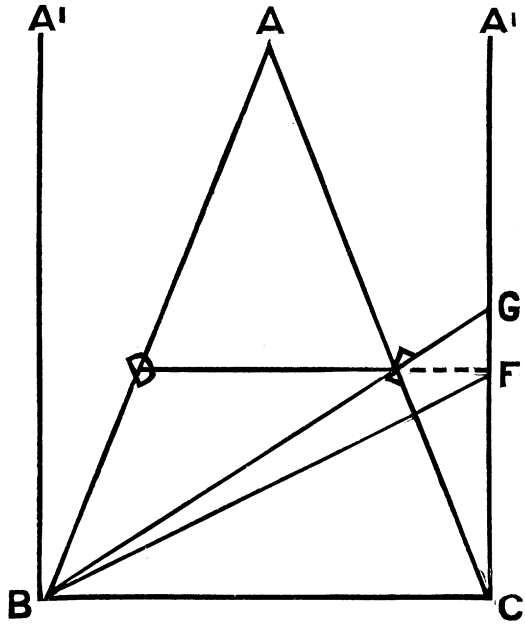
* This essay is entitled: "*De Mundi Creatione ac Fabrica Liber.*"

† An excellent paper on projections, by Lieutenant E. B. Hunt, U. S. Engineers, is printed as Appendix No. 39 to the Report of the U. S. Coast Survey for the year 1853.

for more than a century, attributed the authorship of this modification to De l'Isle, overlooking altogether the merits of Mercator. The astronomer Euler published a treatise on this modification in 1778, naming it after De l'Isle, and evidently supposing that he was the inventor of it. But the celebrated French geographer D' Avezac, in an elaborate paper, read before the Geographical Society of Paris, and published in its Bulletin in 1863, investigated the subject anew and corrected the mistake. It is now undisputed that Mercator used this modification in his edition of Ptolemy, and afterwards in his maps of France and Germany, which appeared in 1585. In fact, the preface to his Ptolemy contains a full and clear description of it.

We now come to Mercator's nautical chart, with its new projection.* I proceed directly to show, as nearly as I can, what it was that he invented. But in order to do this, I shall have to betake myself to the globe and the blackboard. Let me first recall to your minds a few of the characteristics of the terrestrial globe. Of the lines on it which run east and west, we call the central one the equator. It is a great circle, the plane of which passes through the centre of the globe. The other east and west lines are parallel to the equator and to each other, and we call them parallels of latitude. But they are all smaller than the equator, and they diminish in dimension as we proceed from the equator toward the pole. On the other hand, the north and south lines—in other words, the meridians of longitude—are all great circles of the sphere, and all equal to each other ; that is, if we assume that the earth is a perfect sphere, which we do in the artificial globe. We see further, that the meridians are not parallel to each other, like the lines of latitude. They are farthest apart at the equator, and from there they converge until they all unite at the poles. We observe further, that the globe is covered with a web or net-work of four-sided figures, produced by the intersection of the meridians with the parallels. The east and west sides of each of these figures are always equal, but they are not parallel. The north and south sides are always unequal, but parallel. The side which is on the equator, or near it, is always longer than the opposite side, which is nearer to the pole.

* The title of this chart was as follows: "*Nova et aucta orbis terrae descriptio ad usum navigantium emendaté accommodata.*"


A'
A
A'
G
F
B
C

Turning now to the blackboard,* we will suppose the triangle ABC to represent a section (on an exaggerated scale, of course) of the surface of the earth. The point A is the pole or axis of the earth. The lines AB and AC are two meridians of longitude. We will suppose the line BC to be an arc of the equator, and the line DE to be an arc of a parallel of latitude. We will call the distance between the meridians a degree of longitude, and the distance between the parallels a degree of latitude. We will suppose the point B to be the port of departure of a ship, if you please, and the point E to be its port of destination. Then the line BE will be the line which the ship will have to take as its guide, in sailing from B to E. We will next suppose the figure of the earth to be a cylinder, instead of a sphere, and we will accordingly make the meridians of longitude parallel to each other and perpendicular to the equator. They will then be represented by the lines A' B and A' C. Now, it is generally supposed that the peculiarity of Mercator's chart consists in this, that the meridians are parallel. But this is a mistake. He did not introduce the practice of making the meridians parallel, or suggest it. But it existed before his invention. In fact, the definition of Mercator's chart which is ordinarily given is inadequate. It is true, that in his chart the meridians are parallel, but this parallelism is not the distinguishing feature of his chart. It existed in the plane charts in use before his invention. It would lead me too far away from my present purpose, to explain fully the reason of this change from convergence to parallelism in the meridians on the nautical charts. Suffice it to say, that the change was made in order to furnish to the mariner a straight line on his chart as a guide for the course of his ship, in place of the impracticable curve or spiral, commonly called the loxodromic line. But let us now see what distortions are produced by this change from convergence to parallelism in the meridians. We observe that the spaces between the meridians are expanded and enlarged, and this expansion increases more and more as you recede from the equator toward the pole. The degrees of longitude are stretched and lengthened in the same way. The consequence is that the location of the port of destination of our ship is changed from the point E to the point F. Mercator ana-

* See the accompanying diagram.

lyzed this subject, and saw that this change produced a two-fold distortion or misplacement—a distortion in direction and a distortion in distance—in direction, because the direction of the line BF is different from that of the line BE ; and in distance, because the line BF is longer than the line BE. He said to himself, "I will cure the distortion in direction, even if I make the distortion in distance worse than it was before;" and he accomplished it by shifting the location of the port of destination, and pushing it farther north to the point G, so as to bring it into the same line with the points B and E. In other words, he lengthened the degrees of latitude, as you recede from the equator toward the pole, in the same proportion in which the degrees of longitude are lengthened, in consequence of the parallelism of the meridians. He made the distortion in distance worse than it was before, because the line BEG, is longer than the line BF. But he did not mind about that, as his sole object was to furnish a means for guiding the course of a ship. His chart may be defined as one in which the distortion in direction caused by the parallelism of the meridians, and the consequent elongation of the degrees of longitude, is counter-balanced and corrected by a corresponding elongation of the degrees of latitude. You will observe that on all of his charts, the distances or intervals between the parallels increase more and more as you get farther and farther away from the equator, until finally, as you approach the pole, the exaggeration in areas and distances is so great that the chart is discontinued, and no effort is made to represent the regions near the pole.

The practical significance of Mercator's projection is this. He says to the mariner: "If you wish to sail from one port to another, here is a chart and a straight line on it, and if you follow carefully this line, you will certainly arrive at your port of destination. But the length of the line is not correct. I forewarn you that it is not correct. But it points exactly in the right direction. Consequently, if you adhere to the line, you may get to your destination sooner, or you may not get there so soon as you expect. But you will certainly get there."

It is often said, that Mercator was not really the inventor of the projection which bears his name. This is disproven by one of the legends or inscriptions, in Latin, on his chart. I should like very much to show, by a translation of this legend, that Mercator clearly

understood and stated the principle of this projection. But I fear the demonstration would be rather tedious, and I therefore omit it.* English and American writers have generally awarded the credit of the discovery to Edward Wright, of Caius College, in Cambridge. Murray's Encyclopedia of Geography may be cited as an illustration of this. Murray says that it is not known by what principle Mercator constructed his chart, and he makes the following concluding remark :† "Hence it appears, that Mercator did not under- "stand the principles of the map bearing his name, and that this im- "portant invention is due to Wright, who explained it himself, in his

* The following is an extract from this legend:

"In marinis nauclerorum tabulis gradus longitudinum per omnes parallelos usque in polum crescunt supra sphaericam rationem, nam perpetuo aequales manent gradibus aequatoris, at gradus latitudinum minime crescunt, quare ibi quoque distrahi enormiter figuras regionum necesse est, et vel longitudines ac latitudines, vel directiones distantiasque a vero aberrare, et cum magni ea causa errores committantur, ille caput est, quod, trium locorum inscriptione ex uno aequinoctialis latere facta secundum triangularem aliquam dispositionem, si medius quivis extremis justa directione et distantia respondeat, impossibile sit extremos similiter inter se respondere. Quibus consideratis, gradus latitudinum versus utrumque polum paulatim auximus pro incremento parallelorum supra rationem quam habent ad acquinoctialem."

"In the mariners' charts, the degrees of longitude increase in length progressively from the equator to the poles, beyond their relative proportions on the surface of the globe; for they are always equal to the degrees marked on the equator. But there is no such increase in the degrees of latitude. This results necessarily in an enormous distortion in the configuration of countries, and a deviation from the truth in latitudes and longitudes, or directions and distances. Of the grave errors thus arising, the following may be mentioned as the chief: suppose three points be so chosen on either side of the equator, that the lines connecting them form a triangle, and let either be taken as the middle one; if this maintains its proper relative position toward the two outer ones in respect to direction and distance, it is impossible for the latter to maintain their proper relative position toward each other. In view of these things, I have given to the degrees of latitude from the equator toward the poles, a gradual increase in length, proportionate to the increase of the parallels beyond the length which they have on the globe, relatively to the equator."

This last sentence contains a correct statement of the principle of Mercator's chart.

† Vol. I., page 163: Philadelphia Edition of 1840.

" treatise entitled, 'The Correction of Certain Errors in Navigation,' " published in 1599, but written many years before." On the other hand, D'Avezac examines this point with his usual acuteness and vigor, in the paper already mentioned, and he speaks more correctly and with much higher authority than Murray. " Will it be believed," says he,* " that there have been those who, under the pretext that Mer " cator did not explain to the public the successive steps of his cal- " culation, have had the hardihood to deny to him the honor of his " invention ? What matters it, that the formula of it was enunci- " ated twenty or thirty years later by Edward Wright ? The idea " and the material application belonged exclusively to Mercator." And here let me take the liberty to add, that we are specially indebted to this eminent French geographer, for the restoration of the name and fame of Mercator to their proper place in history. Ed ward Wright himself frankly acknowledged the merit of Mercator, and he seems to have had no apprehension that such an acknowledgment would detract from the merit due to himself. In his preface to the work mentioned by Murray, he says that it was " indeed by occasion of that mappe of Mercator," that he first thought of correcting " so many and gross errors and absurdities in the common sea chart." " But the way how this should be done," he adds, " I learned neither of Mercator nor of any else." The truth is, the claims of Wright and Mercator, when judged aright, do not necessarily conflict with each other. Wright simply began where Mercator left off. Mercator invented the remedy which cures the distortion produced by the increase in length of the degrees of longitude from the equator toward the pole, in consequence of the parallelism of the meridians. He compensated and neutralized this augmentation, by giving a corresponding and proportionate enlargement to the intervals between the parallels—in other words, to the degrees of latitude. But there remained the task of practically measuring this increase by the use of numbers. For the accomplishment of this task, Wright availed himself of the science of spherical trigonometry, with its apparatus of sines and cosines, tan-

* " Croirait-on que, sous le prétexte qu'il n'avait pas expliqué en détail au " publie ses procédés de calcul, on osa lui disputer l'honneur de son inven- " tion? Eh! qu'importe qu' Edward Wright en ait, vingt ou trente ans plus " tard, énoncé la formule ? L'idée et l'application matérielle appartenaient ex- " clusivement à Mercator."—*Bulletin de la Société de Géographie de Paris. Tome* 5, 1863, *p.* 315.

gents and co-tangents, secants and co-secants. He finally invented the table of meridional parts, which enables the mariner, by a simple process of numerical computation, to calculate the amount of the increase, at any point, to correct the distances as laid down on his chart, and thus to determine the correct latitude and longitude of his ship. So far as is known, only a single copy of the original of this chart is now in existence. It is preserved at the Imperial Library in Paris. There is a fac-simile of it in Jomard's Antiquities of Geography, which may be found in the library of our Society. It measures seventy-eight and a half inches from east to west, and fifty inches from north to south. The first meridian of longitude is drawn through the Cape Verd Islands. This appears to have been a novelty, originated by Mercator. The chart extends only eighty degrees of latitude north of the equator, and only sixty-six degrees and thirty minutes south of it. It would hardly have answered to push the projection farther toward the poles. The degrees of latitude and longitude become so much expanded and exaggerated, as you recede from the equator, and areas and distances so much distorted, as to render the representation of regions near the poles quite impracticable. In one corner of the chart, however, there is a small separate map of the Arctic regions, laid out upon another new projection, now known as the equidistant projection, but invented likewise by Mercator. This map presents a curious illustration of the fables and vagaries of mediæval geography, from which, as it seems, the mind even of Mercator was not entirely emancipated. A huge black rock, several miles in extent, is represented as rising from the pole or axis of the earth. It is surrounded by an open sea, which in its turn is surrounded by land, through which four rivers, from four opposite points, plunge into the sea with great violence and fury. This representation purports to have been borrowed from the itinerary or narrative of a journey to the north, written by one James Knoyen (or Cnoyen) of Bois-le-Duc. The legends or inscriptions scattered over the oceanic parts of this chart, contain the only explanations that accompanied it. I have mentioned one of them as explaining the principle on which the chart was projected. In another, the author divides the earth into three continents. The first comprises Europe, Asia and Africa, the second the New Indies, as the regions discovered by Columbus were then called, and the third was the great imaginary Antartic continent, extending south from the Straits of Magellan to the pole, and which was deemed necessary as an equipoise

to the large bodies of land north of the equator. All these legends are interesting and important to the student of historical geography, but I shall not venture at present upon any further discussion of them.*

Mercator's chart seems to stand alone by itself, apparently isolated from the rest of his works. It was not heralded by any previous announcement, and no mention appears to have been made of it in his subsequent publications. His personal friends complimented it in high terms, as is usual in such emergencies, but he never profited by it pecuniarily. If it ever occurred to him that this, rather than any other of his productions would immortalize him, he probably banished the idea from his mind long before his death. It seems to have been thrown aside and forgotten, or at least remembered only as a scientific curiosity. Even after his death, his successors did not deem the new projection of sufficient account to give it a place in the Atlas of modern geography. It did not come into use by mariners in his lifetime. They were prejudiced against it, and aside from this, there appears to have been some difficulty in turning it to practical account, until Wright had published his table of meridional parts. I believe it is unknown exactly when Mercator's projection was first used. We only know that about the year 1630, the French seaport of Dieppe, on the English Channel, was the principal emporium for the sale of nautical charts, and that those then sold at that place were mostly on this projection.†

I have spoken of Abraham Ortelius of Antwerp, another eminent geographer, as a contemporary and rival of Mercator. The cordial and lasting friendship between the two ought also to be mentioned. No conflict of interest, or petty jealousy, was ever allowed to disturb it. They encouraged and assisted each other, as if they

* In the fac-simile of this chart, in Jomard's "Antiquities of Geography," the spaces for the legends are unfortunately left blank. Jomard, as appears from his preface, intended to publish them separately. But he did not live to carry out this purpose.

Van Raemdonck gives extracts from these legends in the notes to his biography of Mercator. A copy of them, in the original Latin, may be found in the Appendix to the second volume of Lelewel. Van Raemdonck, in a note on page 133, says that this copy in Lelewel is very inaccurate (*fort incorrecte*), I have no knowlege of any translation of these legends into English. Such a translation is very much needed.

† "Dieppe excellait dans leur exécution; on se servit en 1630, à Dieppe en "premier lieu, de la projection croissante de Mercator pour les cartes marines." —*Lelewel, Tome* 2, *p.* 196.

were brothers. They were natives of the same country, both born on the banks of the Scheldt. As traveling companions, they made the tour of France together. Ortelius was a man of great erudition, but did not engrave his own maps, nor was he a mathematician or practical chartographer.

Many mistaken notions have prevailed in reference to Mercator. From the treatment to which two of his works were subjected by the authorities of the Catholic Church, it has been erroneously supposed that he was a Protestant. I have mentioned his posthumous essay on the Creation, published by his son Rumold. It failed to stand the test of orthodoxy applied to it by the Congregation of the Index Expurgatory at Rome. It was prohibited on the ground that its treatment of the doctrine of original sin bore too close a resemblance to the errors of Luther. His Chronology was also prohibited on account of the extracts contained in it from writings that had been condemned.

Mercator, having lost his wife in 1586, married again. His second wife was the widow of a burgomaster of Duisburg. Of his children, I have only mentioned his surviving son, Rumold. He had two other sons, who died before their father, and three daughters. Arnold, the eldest of his sons, was the individual who discovered at a Benedictine abbey, near Duisburg, the celebrated Ulfilas manuscript of the four Gospels, in the Gothic language, now preserved at Upsal, in Sweden.

I have thus endeavored to trace some of the leading features of the career of one, to whom Malte-Brun paid an eloquent and fitting tribute, when he said: "*Modern geography dates from Mercator.*"* Many items of importance, amusing incidents, and valuable reflections are necessarily omitted. I have not mentioned his work on calligraphy, his "Harmony of the Gospels," or his studies in terrestrial magnetism, and his remarkable letter on this subject to the Bishop of Arras, dated in 1546, before he left Louvain. I have not spoken of the exemplary character of his private life, his social and domestic virtues, his public spirit and active promotion of educational interests, of the high esteem in which he was held by the

* "Gérard Mercator, qui, par son édition de Ptolémée, démonstra l'exrême "imperfection des systèmes des anciens, et en provoqua l'abolition. C'est du "temps de Mercator que date la géographie moderne."—*Malte-Brun. Géographie universelle. Paris,* 1841. *Tome I., page* 274.

people of Duisburg, or of his numerous friendships and extensive correspondence, among others with Hakluyt of England.*

I believe, however, that to the extent of my limited time and abilities, I have performed the task that was undertaken, upon the suggestion of the learned President of our Society. He placed in my hands the discourse of Dr. Breusing at Duisburg, and asked me to read it. At the same time he intimated to me that it was exceedingly important and desirable, that we should have in the English language, some account of Mercator more extended, authentic, and intelligible than any which we now possess. This acknowledgment leads me to remark, in conclusion, that the memory of Mercator has been sadly neglected by those races who, most of all ought to have cherished and perpetuated it. I refer to the English speaking races. For more than two hundred years they have used his invention in every quarter of the globe, to build up their commerce and enrich themselves. Whoever makes the paths of the sea easier—whoever lessens the dangers and lightens the hardships of the sailor's life—deserves to be remembered. But the very existence of Mercator, even in the minds of our intelligent and educated seafaring men, seems to have been hitherto hardly anything but a name. I have searched diligently through the pages of English literature for some account of him, but I have found nothing more full or complete than the few lines in the current cyclopedias of the day. The histories of the times in which he lived, like those of Hallam, Robertson, and Motley, do not even mention his name.† Is it not high time that some amends, of some kind or other, should be made for past delinquencies in this respect? If so, then this Society and this audience, may justly take to themselves the credit of being the first to make such amends, by devoting an evening to the consideration of the subject which has occupied your attention.

* In Hakluyt's "Collection of Voyages," Vol. I, p. 443 (London, 1598), there is a letter from Mercator, written in 1580, and advocating an expedition for the discovery of a northeast passage to Cathay.

† In the forty-seven volumes of the "Journal," and the twenty-two volumes of the "Proceedings of the Royal Geographical Society," I have not been able to find any information concerning Mercator.

In a letter received from Dr. Breusing since the reading of the foregoing paper, he tells me that I am mistaken in respect to Mercator's religion, and that he was a Protestant. The subject is not discussed in Breusing's discourse at Duisburg, and I can only say, that on this point I followed Van Raemdonck, who seemed to me to show pretty clearly that Mercator was always a Catholic.

REMARKS BY J. CARSON BREVOORT.

MR. PRESIDENT—I rise to move that the Society tender to its Recording Secretary, Mr. Hall, its thanks for his interesting and ably-drawn sketch of the Life and Works of Gerard Mercator, just delivered, and that he be requested to furnish a copy of it for publication in the journal of the Society.

While dwelling on the great assistance afforded to navigators by the Mercator projection of charts, and by the various methods of observation at sea, by the accurate tables and improved instruments, it has occurred to me that Americans also have contributed valuable help toward the same end, which deserves and ought to be commemorated by this Society.

I allude to Godfrey's Mariners' Bow, a practical double-reflecting sextant, invented by him in Philadelphia in 1730, really the first instrument of its kind ever used at sea, and the originality of which was recognized by the Royal Society in 1734, though another similar one was proposed by John Hadley, Vice-President of the Royal Society, in London, nearly at the same time, and which in an improved form has since been in use, and bears his name.

Another contribution to the mariner's art was made here in 1842, by Captain Sumner, of Boston, who first practiced a mode of using the method of observing by equal altitudes for determining the position of a ship at sea. The method, with some improvement in working the formula, has been gaining ground rapidly, is in use in our navy, and in England, and has led to the publication of tables adapted to its practice, by Sir William Thomson. In France a book has been recently published, to recommend and facilitate its use.

We have, also, for some years been able to publish a nautical almanac, which has attained among mariners perfect confidence in its predictions, and which, under the able superintendence of Prof. J. H. C. Coffin, has, perhaps, surpassed the well-known and long-used English one.

Let us preserve the memory of the two men first mentioned, and place their names on the list of benefactors to mankind, along with that of the great German geographer, whose career we have followed this evening.

REMARKS BY PROF. W. WRIGHT HAWKES.

MR. PRESIDENT—It is with pleasure that I second the motion of Mr. Brevoort for a vote of thanks, on the part of this Society, to Mr. Hall, for his instructive and interesting lecture on Gerard Mercator, to which we have just listened. Lectures of this kind lay the foundations of this Society deep in public esteem. The instruction such discourses give, makes indeed the "trade dollar" of all rhetoric of little value, when compared with the solid gold of the information they convey.

Gerard Mercator, as Mr. Hall has shown, must be classed in the noble ranks of the men who, in their day and special vocations, devote themselves, through great personal sacrifice, to the cause of great practical good. They are not only sufferers, thinkers, and workers, but they promote thought and work on the part of others. Unlike the achievements of brilliant military heroes, their labors do not dazzle. Their fruits endure! Indeed, the very extent of benefit these labors confer, makes their results such common property, that mankind is apt for a time to forget the powerful individual intellect and self-devotion to which the wide-spread blessing is owing. Hence, it is a noble task to recall the long omitted debt of gratitude. He, therefore, who accomplishes that task, with the ability displayed by Mr. Hall, may justly feel an honest pride in thus, in a measure, linking his own name to that of the benefactor to whom the world owes so much.

But it is also most fitting, Mr. President, that the life and labors of the great cartographer, Mercator, should have been chronicled before the American Geographical Society. Nor can there be a more appropriate city for such a discourse than this great mart of the Western World, whose sails, in former years, whitened every sea, and whose stanch and rapid keels were found in every port. Let us hope that similar bright days for our mercantile marine may be witnessed at no distant time, when the present bitter hour of pressure shall be passed. When that time shall come, it will bring fresh and enlarged occasion to acknowledge our obligations to Mercator, who, centuries ago, projected charts on principles which are to this day essentially adopted by marine cartographers.

But who can enumerate the benefits flowing from any valuable contribution to the science of navigation, and especially from one

like that of Mercator! To attempt it is to cause the mind to lose itself in endless visions.

I therefore close these brief remarks by again warmly seconding Mr. Brevoort's motion for a vote of thanks to Mr. Hall, for the opportunity he has afforded a New York audience of publicly recognizing the lasting services rendered to the world by Mercator.

REMARKS BY CHIEF JUSTICE DALY.

Mr. Hall has referred to my having suggested the preparation of this paper. I did so because there is not, at least so far as I have been able to find, any satisfactory account in the English language of Mercator's life and labors; and I am exceedingly gratified that my suggestion has led to such a complete and satisfactory account of the man, and of what he did, as we have listened to this evening. It has required no ordinary research, and research in several languages, to get all the facts together which Mr. Hall has incorporated in this interesting memoir, in which justice has at last been done in our own language to one to whom the great commercial and navigating nations of England and the United States are so much indebted for the invention of the projection which is still the foundation in every chart that is constructed for the use of the mariner.

The value of the simple means which Mercator devised to enable the mariner to sail more effectually in a straight line across a curved surface, in going from one port to another, can only be duly appreciated by examining the charts that were in use before his time, covered as they are with trigonometrical lines radiating from central points, according to the course of the compass, to indicate the direction and the distance, several of which will be shown to you through the stereopticon. The view of the entire surface of the earth upon one map, by what is called Mercator's projection, is still incorporated in every atlas, because it shows the relations of the different parts of the world to each other better than two round maps or planispheres, which represent the two halves of the globe flattened out upon a plane surface; and, familiar as every one is with this map, few know anything of the man that devised it, except that it bears his name; for Mercator was of that class of unobtrusive scientific men from whom mankind frequently receive so much and acknowledge so little. The labors of the cartographer do not attract the attention of the world like the discovery of a continent by Columbus, or the exploration of a great African river

by Stanley. The labors of the one are, nevertheless, as important as those of the other, but the estimate of the two is very different. What Dr. Johnson said in the preface to his Dictionary respecting the lexicographer, may with equal truth be applied to the cartographer, that "he is the slave of science; others may aspire to praise, but he can only hope to escape censure, and is disgraced by miscarriage, where success would have been without applause, and diligence without reward." Such has been the case with Mercator, and Mr. Hall is entitled to the thanks of the Society for having rendered in the English tongue this long-deferred tribute to the memory of a man who is certainly entitled to be classed amongst the world's benefactors.

APPENDIX.

I.

BY J. CARSON BREVOORT.

GODFREY'S MARINERS' BOW.

The first idea of a portable reflecting instrument for use at sea, occurred to Doctor Robert Hooke, and is alluded to in general terms by Thomas Sprat in his History of the Royal Society, 1667 and 1702, page 246, but is not there ascribed to him. It was, however, his invention, as it appears in Hooke's Posthumous Works, edited by Waller, 1705, page 503, plate 11, no. 2. We have not been able to consult the work, but learn from other sources that it was very much like an instrument designed by Sir Isaac Newton, and communicated to Doctor Edmund Halley about the year 1700, but which Halley did not lay before the Royal Society. The note by Newton was found among Halley's papers after his death, and is printed in the Philosophical Transactions, Vol. XLII., for 1742, page 155. Neither of these proposed instruments appears to have been constructed or tried.

The reward of £20,000 offered by Act of Parliament 12th April, 1714, to any one who could determine the longitude at sea within half a degree, set many ingenious minds at work to solve this problem. Generally, attention was directed to making more accurate timekeepers, and in 1726 one-half the reward was paid to John Harrison for such a one, and the other half to the same person after the trial of one of his timepieces by Captain Cooke in 1772 to 1775, on his

voyage round the world. As, however, the observations for time required a correct instrument for taking altitudes of the celestial bodies, other inventors tried to construct something better than Davis's quadrant, which came into use in or about the year 1600.

Thomas Godfrey, an ingenious mechanic of Philadelphia, had been allowed by Mr. James Logan to study in his library, then the most extensive one in British America. In October, 1730, he constructed an instrument very much on the same principle as the unpublished one of Newton, and begged Logan to lay it before the Royal Society, and to claim for him the reward offered. Logan, however, delayed writing until May 25th, 1732, when he sent to Doctor Halley a description of the instrument. Logan, on the 28th of June, 1734, had himself exhibited the "Mariners' Bow," as Godfrey called it, before the Royal Society, stating that it had been tried and found of great use soon after its invention. Godfrey wrote also, November 4th, 1734, to the Royal Society about his "Bow."

The instrument had been used in Delaware Bay in February, 1731, by Joshua Fisher of Lewistown, and again on a voyage to Jamaica, W. I., where it was exhibited to several gentlemen, among others to a nephew of Hadley, the astronomer. On an examination as to priority of invention, by the Royal Society, Hadley proved that his instrument, constructed on the same principle as Godfrey's, was invented in the Summer of 1730, that it was noticed at a meeting of the Society May 13th, 1731, and exhibited May 27th, according to the Transactions, Vol. XXXVII, page 147. On the report of a committee, it was decided that the American and English instruments were independent inventions, and the Society awarded to Godfrey £200 in furniture and a clock, not giving him money, as it was alleged that his habits were bad.

Logan complained of this treatment of his *protégé*, but his remonstrance was not printed in the Transactions. There can be no doubt that Godfrey constructed the first practical marine double-reflecting instrument that brought down the image of the sun to the horizon, giving the altitude in degrees of half the natural length, and enabling observers to measure 120° on an arc usually occupied by 60°.

Hadley's instrument was much improved by Captain Campbell in 1757, and in its present form can hardly be called by the name it bears. Hooke, Newton, Godfrey and Hadley all invented an instrument founded on the same principle. The first two were never constructed, but the last two were invented nearly at the same time, and the American one was at once made and used, while the

English one was not exhibited until almost a year after its supposed invention.

We refer for authorities and details to *The Register of Pennsylvania*, March 29th, 1828, p. 193, for letters and statements copied from the *Am. Mag.* for July and August, 1758, with a cut of Godfrey's Bow; to the *Am. Journal of Sciences and Arts*, Vol. XXXV, Jan., 1839, p. 389; to the *Historical Collections of Pennsylvania*, 1843, p. 595, by Sherman Day; to the *Memoirs of Sir Isaac Newton, by Sir David Brewster*, 1855, Vol. I, p. 242; to the *English Cyclopædia*, 1861; *Arts and Sciences*, Vol. VII, article *Sextant*, and to the works quoted in the text of this note.

II.

SUMNER'S METHOD BY EQUAL ALTITUDE OBSERVATIONS.

Captain Thomas Hubbard Sumner used equal altitude observations on the first voyage which he made as a shipmaster, shortly before 1842. Born in Boston 1807, graduated at Harvard in 1826, he followed a seafaring life until about 1847, when he became affected with a cerebral disease that incapacitated him for any mental labor until his death in 1876.

The first publication of his practical method of using equal-altitude observations at sea, appeared in 1843, and soon found favor with intelligent mariners. It was recommended by Professor Benjamin Peirce, Chief of the Cambridge Observatory at that time, and the Navy Department ordered every ship in the United States navy to be supplied with a copy of Sumner's book. Professor John H. C. Coffin, U. S. N., and Superintendent of the American Ephemeris and Nautical Almanac, says: "Sumner's method as taught by others is excellent."

Lieutenant H. Raper, R. N., author of a treatise on navigation, gave it a full and favorable notice in the *Nautical Magazine*, and it was immediately adopted wherever it was made known. Six editions of the original pamphlet have appeared up to 1866. In 1866 an English edition of Sumner's method, accompanied by another one of Captain Lewis Page's, by simultaneous altitudes, was published by Imray and Son, nautical booksellers, in London, and edited by Lieutenant Raper. In the preface, the following expressions are used: "Most navigators have heard of, if they have not practiced, Captain Sumner's method of finding a ship's position at sea." * * The writer would rather call attention to the fact "that while Cap- "tain T. H. Sumner, of the United States, deserves credit for the

" endeavor to make public a method he had himself used with ad-
" vantage, it appears that Commander Thomas Lynn, of the H. E.
" I. C. Service, had published a small pamphlet on the same subject,
" *Practical Methods by Trial and Error for finding the Latitudes*
" *and Time at Sea*, ten years earlier than Captain Sumner's first
" edition of 1843; but it did not attract the attention it merited."
It does not appear that the Lynn method was the same as Sumner's, for were it so, Raper would not have preferred the latter one.

Sir William Thomson, according to an article in *Nature* (Vol. XV, p. 22), describing and commending the method, has prepared elaborate tables to facilitate the Sumner observations, and a large volume has recently appeared in France on the same subject. Our American navigator has thus certainly added to the safety of navigation, and we trust that his name will not be omitted from the list of benefactors to commerce and navigation.

We may properly add here that the Reverend Doctor Thomas Hill, LL.D., of New Jersey, once President of Harvard College, and now pastor of a church in Portland, Maine, has invented an instrument which he calls the *Sumner*, or the *Nautrigon*. This contrivance solves several important problems in navigation without resorting to logarithms, and is especially adapted to working out the Sumner method, which led to the invention of the instrument. A pamphlet explaining its use appeared at Portland in 1876.

III.

ERRORS IN MERCATOR'S FIRST PROJECTION.

The graduation on the Crosstaff or Jacobstaff, used by navigators from a very early date, or an attempt to increase the degrees of latitude by a geometrical method from a globe, may have led Mercator to his new projection. It is, however, on his map, only approximately correct up to Lat. 40°, where it differs by $\frac{4}{100}$ from a table of meridional parts. Even in the higher latitudes it is not over $\frac{7}{100}$ in error. He may have been restrained from giving full scope to the method by the fear of giving too much space to the Northern regions.

In the small diagram entitled *Directorium Organum*, placed in the southeast corner of his map, the graduation is more correct, and not much over $\frac{2}{100}$ short of the true one. This diagram further proves that he fully appreciated the value of his projection to mariners, for he has drawn upon it two sets of compass or wind points, as if to exhibit the remarkable property possessed by it of giving the true bearings, even on a plane surface.

IV.

WILLIAM BARLOWE ON THE MERCATOR PROJECTION.

Edward Wright's book first appeared in 1599, and it may justly be considered as the first practically correct treatise on navigation, as depending on accurate observations, tables and charts. He may have ascertained the true formula for laying down the Mercator projection some years before this date, but the first one to publish a correct geometrical method for doing this was William Barlowe. In 1597 Barlowe published a small work entitled "The Navigator's Supply, &c.," in which, in chapter 7, and last, we find the following passage, which we give in his own words:

"The third sort of Cardes have both their *Meridian* and *Parallels* "of straight lines equidistant, and these only are in ordinarie use "with Sayler's. Of these I need not write anything, they are so "commonly known, and their imperfection in long voyages so "manifest, though in short they may well serve the turner. And "yet I cannot here conceale one great secrete concerning their "Cardes, namely, that there is a certain draught of them very arti- "ficiall and regular, which being well understoode, redresseth the "errors of the other; and (as farre as I canne discerne) will so "satisfie the navigator's expectation, as no carde hitherto invented "was ever comparable with it, neither (as I thinke) any that shall "be hereafter wil in al respects surpasse it. Although for the "geographicall description, they may and must alter from time to "time, as newer discoveries by light of trueth shall make them "better knowen unto us.

"This manner of Carde hath beene publiquely extant in print "these thirtie yeeres at least, but a cloude (as it were) and thick "myste of ignorance doth keepe it hitherto concealed; and so much "the more, because some who were reckoned for men of good "knowledge, have by glauncing speaches (but never by any one "reason of moment) gone about what they coulde to disgrace it. "The Carde (which I meane) is the same that was set foorth by the "excellent *Cosmographer Gerardus Mercator*, in sheeve resembling "ordinarie Sea Cardes, save that the degrees of the *Meridians* in "it doe proportionally encrease from the *Equator* toward each "*Pole*, upon good reason and firme Demonstration, thereby show- "ing the true Position of any one place in respect of an other; "which the usuall Cardes in a farre distance cannot doe, being yet "the very principall point that the Navigator desireth."

"For the better understanding and making of Sea Cardes of that

" sort, I have here immediatly ensewing set downe a demonstration, " which I obtained of a friend of mine of like profession unto " myself, evidently showing the proportionall encreasing of these " degrees, wherein consisteth the excellencie of that Carde."

He then gives details, assisted by a small engraved diagram, entitled " The Demonstration of the increasinge of the Degrees, in the Meridians of Mercator's mappe." The demonstration, too long to be copied here, shows that the projection may be laid down from the intercepted secants for each rising degree of latitude.

The passage quoted is interesting, as it shows that many had sought for the true Mercator projection, while others had violently denounced it. The author's own opinion of its merits has been justified by time. Wright only developed fully a problem that seems to have been already solved. He seems to have published the first table of meridional parts as given by calculation, even carrying them up to latitude 89° 59′. If a chart, on a scale of ten equatorial degrees to an inch, should be constructed, his last figures would require for one minute only, a space of 282 feet.

Martin Cortes, though credited by Wright with having proposed an increasing projection, in the second chapter of his " Breve Compendio de la esfera y de la arte de navigar," of 1551, (published in English in 1561, as the Arte of Navigation), did not do this, as an attentive perusal of his text will show.

V.

MERCATOR'S FIRST MAPAMUNDI OF 1538.

Mercator's first published map was one of the Holy Land, on a large folio sheet, dated 1537, but no copy of it is now known. His biographers quote one of Flanders, dated 1540, as his next production, and in 1554 his great map of Europe appeared, but of neither of these is there a copy preserved. We have in our library, however, a small engraved *mapamundi*, drawn on the so-called double cordiform projection, by Mercator, a method first used, we believe, by Oronce Fine, the French mathematician. Fine's map is a finely executed woodcut, 39.2 by 28. cent., exclusive of the framework, and dated July, 1531. It is found in the Paris edition of the collection of travels, in Latin, made by Simon Grynœus, and published at Basle, both editions being dated 1532. The Basle edition has a poor map by Sebastian Münster, of the New World only, copied from Apianus.

Mercator's map is 48.5 by 30.5 cent., without the frame, and appears in part to have been copied from the one by Fine, but

differs from it in many points. Both of them run the prime meridian through the Cape Verde Islands, and both place 90° to the west of it. Each of them divides the globe at the equator, and it is evident that the one has suggested the other. In the geographical delineation a signal difference exists, in that Fine joins America to Asia, while Mercator divides these continents by a narrow ocean. They differ much in the longitudes of the newly-discovered regions and in the North Polar outlines.

Mercator has the following legend above in a scroll: "Lectori " S. quam hic vides orbis imaginem lector candide eam ut posteri- " orerem, ita & emendatiorem ijs qæ hactenus circumferebantur esse " America, Sarmatiaque ac India testantur. Proposuimus autem " partitionem orbis in genere tantum, quam deinceps in particulari- " bus aliquot regionibus latius tractabimus, atque adeo in Europa id " iam facimus, quam brevi non minorem universali illa Ptolemei " expectato. Vale 1538."

We can hardly translate this involved statement literally. Mercator says that in this image of the world he has made use of the most recent explorations, and that he proposes to take up each part of the world separately, and is now engaged on Europe, thus doing as Ptolemy did, in a brief but not less universal way.

Below, endorsed in a scroll also, is the dedication: "Joanni " Drosio suo gerardus M....r Rupelmudanus [*sic*] dedicabat." This legend is somewhat damaged. The map, yellow with age, appears to have laid folded twice transversely, and shows defects along the creases. It has been pasted on two blank leaves and bound in a copy of Mercator's Ptolemy of 1578, between the maps and the Index. This was probably done by Mercator himself, and this particular copy was presented to a friend and patron, for at the foot of the title we read, in the neat italic script which he introduced into maps, the inscription: "D. Lollio Aedama amico sum- " nopere colendo Gerardus Mercator, dd."

The binding of the volume, in half muslin, is quite modern, but it was, no doubt, once more richly dressed. It was imported by me many years ago without any notice of the interesting relic it contained, which proves to be the oldest engraved work of Mercator preserved to our time, and but one year later in date than his first published work, the map of Palestine. It is also his first attempt to design the whole globe on plane surface. His great mapamundi, it will be remembered, is dated 1569.