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THE LAW

OF

ORESME, COPERNICUS, AND GRESHAM





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OF

## ORESME, COPERNICUS, AND GRESHAM

A PAPER READ BEFORE

THE AMERICAN PHILOSOPHICAL SOCIETY

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BY

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## NOTE.

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IN preparing this paper I have consulted the original manuscripts of Oresme and Copernicus edited by Wolowski and published by Guillaumin in 1864, and also Burgon's life of Sir Thomas Gresham printed in 1839.

T. W. B.

PHILADELPHIA, May, 1908.





THE LAW  
OF  
ORESME, COPERNICUS, AND GRESHAM.

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BY THOMAS WILLING BALCH.

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AMONG the most certain laws known to economic science is the one that, when two moneys of unequal value are placed in circulation at the same time side by side as currency of the realm, the poorer or cheaper will drive the better or dearer from circulation. This law, though fought over most strenuously in this country within recent years, as if its immutable operation had not been thoroughly demonstrated in past ages of humanity, was known in part at least to the Ancients. Of this there is ample proof in the *Frogs* of Aristophanes. In that play, the foremost comic poet dramatist of Greece places in the mouths of the chorus these lines:—

“Oftentimes have we reflected on a similar abuse  
In the choice of men for office, and of coins for common use;  
For your old and standard pieces, valued and approved and tried  
Here among the Grecian nations, and in all the world beside,  
Recognized in every realm for trusty stamp and pure assay,

Are rejected and abandoned for the trash of yesterday;  
For vile, adulterate issue, drossy, counterfeit and base,  
Which the traffic of the city passes current in their place."<sup>1</sup>

In the above quotation it is distinctly shown that the better coins that had been current were driven out and replaced by pieces of inferior value. And as a poetic mind like that of Aristophanes could hardly have understood, much less have discovered such a subtle unwritten law of money, had not some knowledge of it been the common possession of the intellectuals of Greece in the epoch in which he lived, we can infer from Aristophanes's statement of it, that the Grecian States passed through the ups and downs of a change in the standard of value caused by a debasement of the currency.

The same state of affairs existed among the Romans, and the amount of benefits and evils that obtained in the reign of each Roman Emperor can in a measure be judged by the greater or less purity of the coinage issued in their respective reigns.

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<sup>1</sup> Frere's translation.

In Bohn's Classical Library this passage is thus rendered: "The freedom of the city has often appeared to us to be similarly circumstanced with regard to the good and honorable citizens as to the old coin and the new gold. For neither do we employ these at all, which are not adulterated, but the most excellent, as it appears, of all coins, and alone correctly struck and proved by ringing everywhere, both among the Greeks and the barbarians, but this vile copper coin, struck but yesterday and latterly with the vilest stamp."

The experiences of the Ancient World with money as the mechanism of exchange were largely unknown to the peoples of the Middle Ages, and they had to discover for themselves at a great and bitter cost that any attempt to debase the currency only results in the good money disappearing from circulation to the ruin of the commonwealth and of its inhabitants, especially of the poorer members.

Three men, exercising three different callings, but all three profound students, and two of them ranking among the scholars of the world, in three different countries, in three distinct periods of time, discovered independently of one another and explained to their respective sovereigns that when into the currency of a country a poorer or cheaper money is injected by the side of a better which is the standard of value, the certain and immutable result will be that the currency of the realm will be debased to the standard of the poorer money. For as it will then be possible to pay debts in either money, people will naturally pay them in the cheaper currency, selling the better money by weight at the premium that it will command in the standard of the poorer currency.

These three men were Nicole Oresme, Bishop of Lisieux in Normandy, who stated this subtle unwritten law of money for Charles the Fifth of France,



surnamed the Wise; Nicolaus Copernicus of Thorn in Prussia, the discoverer of the Copernican theory of Astronomy, who expounded this same law of the currency for Sigismund the First of Poland; and Sir Thomas Gresham, a noted English merchant, who explained it to Elizabeth of England. It is proper then that in honor of these three discoverers of an economic truth that is a precious thing for humanity to know, that this law should be called the Law of Oresme, Copernicus and Gresham.

Oresme and Copernicus each prepared a learned and comprehensive treatise for their respective sovereigns on the practical functions and workings of money, and Gresham wrote a letter to his Queen in which he pointed out to her that good and bad coin could not circulate together. No branch of science arises all developed at one bound from the brain of a single man as Minerva sprang all armed from the head of Jove. It advances by successive degrees, as one scholar after another, armed with the knowledge acquired by his predecessors, develops further what the human race knows of the laws of the universe. And as Hugo Grotius, who assembled from all points of the compass the rules and usages that Princes and cities observed in his day in their relations one with another in his monumental work, *De Jure Belli ac Pacis*, and gave them a further advance in the trend of a humane and civilized development, has justly been called

ever since the father of the science of International Law, so Nicole Oresme and, a greater man than he, Nicolaus Copernicus, for their pioneer work in the exposition of the true rules that govern money as the medium of commercial exchange, have just as truly been described by MacLeod as the Castor and Pollux of Monetary Science. They both delved into the past experiences in the matter of money of their respective countries, and probably made use of much of what the Greek and the Roman publicists had said on the subject. The work of Grotius first redounded to the advantage of humanity by the application of many of the humane principles that he advocated by their practical adoption by Gustavus Adolphus of Sweden in the terrible Thirty Years War. The light shed by Oresme and Copernicus on the functions of currency first helped to lighten the burdens of humanity through their application by Charles the Fifth of France and Sigismund the First of Poland. And a generation after the true expounder of our solar and planetary system had prepared his treatise on money, Sir Thomas Gresham likewise, through Elizabeth of England, aided the human race to derive the advantages that are conferred upon society by an honestly maintained measure of value.

The importance of the economic work of Nicole Oresme was first revealed to the world at large in 1862 by William Roscher, Professor of Political

Economy in the University of Leipzig. Oresme's master work, *Tractatus De Origine, Natura, Jure et Mutationibus Monetarum*, was often referred to before that time. But in every case before Roscher saw Oresme's work in manuscript, the examiners of Oresme's learned and lucid treatise failed to grasp its real importance. When, however, it came under the eye of Roscher, a trained economist, he saw at once the profound significance of the work. Under the title of "A Great French Economist of the Fourteenth Century," Roscher called the attention of the world to Oresme's treatise on money. Two years later the French naturalized Pole, Louis Wolowski, also signalized to his adopted country the work of the fourteenth century economist.<sup>2</sup>

Nicole Oresme, who may be looked upon as the first scholar, so far as we now know, to expound comprehensively money as the mechanism of exchange, was by birth a Norman. He studied at the University of Paris, where he was classed in the Norman nation. At the University, Oresme was reputed to be the most able and learned in his knowledge of the sciences and the fine arts. He translated at the request of Charles the Fifth the *Ethics*, *Politics*, and other works of Aristotle. He

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<sup>2</sup> *Traictie de la première invention des Monnoies de Nicole Oresme* textes français et latin d'après les manuscrits de la Bibliothèque Impériale et *Traité de la Monnoie de Copernic*, texte latin et traduction française publiés et annotés par M. L. Wolowski, membre de l'Institut. Paris, Guillaumin et Cie., 1864.





delivered at Avignon on December the 24th, 1363, before Pope Urban the Fifth and the members of the sacred college a sermon in which he censured the high clergy of France. Charles also commissioned him to translate the Bible, in order that this vernacular version might be opposed to that of the Waldensians.

When Charles the Fifth succeeded to the throne of his ancestors, the French, crushed by what was for those times an enormous debt, were groaning under the weight of the accumulated mismanagement of previous rulers, and the "*royaume des lys*" had shrunk to small proportions before the English invasion, and was fast disappearing in misery and anarchy. Owing to the capture of Charles's father, King John, by the English, Charles was called upon to act as regent. During those years he learnt much which later as king he put to valuable practical use. Reigning from 1364 to 1380 under the title of Charles the Fifth, he was, for his able management of the affairs of his kingdom, justly surnamed the Wise. This honorary title, Charles the Fifth, who was a capable and sagacious man, was entitled for in great measure to the fact that he surrounded himself and relied upon the services of men of first rate ability who had strengthened their natural capacities by hard work, such generals as the Breton, Bertrand du Guesclin, such scholars as the Norman, Nicole Oresme. It was

Charles the Wise, too, who, in beginning the first collection of manuscripts in the Louvre, that afterwards became the Bibliothèque Royale, then the Bibliothèque Imperiale, and to-day is known as the Bibliothèque Nationale, was the founder of what is to-day the largest depository of learning in the world.

The chief cause of the unhappy state in which the French people found themselves when Duc Charles became king in 1364 was in large measure due to the tampering by their rulers with the weight of the value of the coins of the realm. Many of the French kings had thought to raise revenue by forcing their people to accept a debased coinage. Of these royal false coiners, Dante flays Philip the Fair (1285-1314) in the *Paradiso* in these words:

“La si vedra il duol che sopra Senna  
Induce, falseggiando la moneta.”<sup>3</sup>

In addition to debasing the coinage, the French Sovereigns again and again changed the mint price of gold and silver. In the reign of King John the Second, the value of the *livre tournois* was changed between 1351 and 1360 no less than seventy-one times.<sup>4</sup> And what made the resulting confusion from this unjustified and foolish

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<sup>3</sup> “There shall be seen the woe that he shall pour  
Along the Seine by debasing the coinage.”

<sup>4</sup> Wolowski.

meddling with the measure of commerce still worse, was that sometimes the value of the *livre tournois* was raised and sometimes it was lowered. As a result, far from filling the coffers of the king this policy prostrated commerce, and the wealth in the realm of France shrank. When Charles the Fifth, upon his father's death, ascended the throne, he called upon Nicole Oresme, in order that he might reform the coinage of France, to shed light upon the confused currency of the kingdom. And thus it was that Oresme prepared his most important work, already referred to, the first comprehensive treatise upon money, entitled *Tractatus De Origine, Natura, Jure et Mutationibus Monetarum*.

Of this work many manuscript copies of the Latin original were made, and also of a French translation by the author himself under the title, *Traictie de la premiere invention des monnoies*. This translation was placed as early as 1373 at least in the library collected by the direction of King Charles in the Louvre.

Oresme, in stating the various workings of money as the mechanism of exchange, explained in precious words to his sovereign that, whenever the public currency was altered or tampered with in such a way as to bring into circulation two moneys, bearing the same designation but in reality having two different values, the money



of lower value inevitably drove the money of higher value out of circulation. For the merchants found it to their advantage either to melt down the pieces of money that contained the higher amount of metal and to sell the bullion by weight or else to export the high weight coins to other lands. Thus Oresme says: "The rate of exchange and the price of the moneys must be for the kingdom as a law and a firm ordinance which in no way must alter or change." And further in speaking of the ratio of exchange between gold and silver, Oresme points out that the value or proportion in which those metals are exchanged in their natural state, is the rate of exchange that must be maintained between gold and silver currency. For if a given amount of gold is worth twenty times as much silver, then a *livre* of gold would be worth twenty *livres* of silver, a *mark* of gold twenty *marks* of silver. "But always this proportion," he says, "must follow the natural habit or rate of gold to silver, in value." The mutations of the currency are of great peril to the national welfare "for the injury which comes by it," he says, "is not so soon felt nor seen by the people, as it would be by another tax, and nevertheless no such nor similar can be more grievous or greater; and, in addition, gold and silver, by such mutations and changes, shrink and diminish in a kingdom, and in spite of all



vigilance and prohibition that may be taken, they go abroad where they are accorded a higher value for, by adventure, men carry more voluntarily their moneys to the places where they know these have a greater value."

The luminous treatise of Oresme on money opened the eyes of King Charles to the disastrous results to a country whose government attempted to alter the basic value of its currency. As regent of France during the captivity by the English of his father, King John the Second, who was captured at Poitiers in 1356, Charles had not escaped the prevailing custom among rulers of that epoch to fill the royal purse by debasing the coins of the realm. In the previous century the great ordinance of 1255, which the States Generals of France, assembled at Paris, obtained from the king, Louis the Ninth, promised sound and stable money for the whole Kingdom of France, so that the mark of silver should never produce more than six *livre tournois*. This royal promise was broken again and again by the French sovereigns, and Duc Charles, as regent for his captive father, said the value of the mark should be worth twelve *livre tournois*. This cutting in half of the measure of value was the signal for the great rising at Paris in 1357 under Etienne Marcel, the Prevost of the Paris merchants, and it was with difficulty that the regent reasserted the royal authority in the

city.<sup>5</sup> The distracted and poverty stricken state of the people and the low ebb of the kingly power, reenforced by his practical experiences as regent, caused Charles the Wise, though of a physique so frail that he could not march at the head of his army in those years of strife and peril, yet endowed with a superior mind and seeking the advice of sage advisers, to set himself to reorganize the finances of France. The luminous thoughts expressed in the treatise of Oresme he made his own, and during his reign the weight of the gold currency remained a fixed and unchanged quantity, and that of silver was but very triflingly altered. The resulting stability in the value of money, the measure of commercial exchange, re-established the regularity of commercial transactions, and furnished an important element to public prosperity. The resources of the realm augmented and with them the power of King Charles grew. To honor the scholar who had made plain the confusion that resulted from tampering with the standard of value, the money of the realm, King Charles had Oresme elected in 1377 Count Bishop of Lisieux in Normandy. And it was there, two years after the king's death in 1380, that the great economist died on July 11th, 1382, regretted especially by the scholars of his day.

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<sup>5</sup> Wolowski.

The economic truths that Oresme so well stated in his treatise on money did not become widely known, for his work was written for his king's information, and Gutenberg had not yet made it possible through printing to give them a wide circulation. The truths that Oresme taught and upon which Charles the Wise acted, to the profit of his kingdom and therefore of himself, became in great measure forgotten. A century and a half after Oresme's death they were rediscovered and restated a second time. In the year 1526, in a Latin treatise entitled *Monete Cudende Ratio*, written at the request of Sigismund the First, King of Poland, and his Chancellor, Szydlowiecki, Nicolas Copernicus of Thorn in Prussia, who had elucidated for mankind some of the celestial harmonies, gave to the world an exposition of some of the economic truths. Independently of the work of Oresme, of which the Prusso-Polish scholar knew nothing, Copernicus made clear for his sovereign that two moneys of unequal value could not be kept in circulation at the same time. "Gold or silver," he writes, "marked with an imprint, constitutes the money which serves to determine the price of things that are bought and sold, according to the laws established by the State or the Prince. Money is therefore in some sort a common measure of estimating values; but this measure must always be fixed and must conform to the established rule. Otherwise, there





would be, necessarily, disorder in the State: buyers and sellers would at all times be misled, as if the ell, the bushel or the weights did not maintain constant quantity.

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“The establishment of money has necessity for cause. Though in weighing only gold and silver it would have been possible to practice exchanges, those metals, from the unanimous consent of men, being considered everywhere as precious things, nevertheless there would be numerous inconveniences to have to carry always weights along, and, all the world not being apt to recognize at the first glance the purity of gold and silver, it is agreed everywhere to have money marked by government with a stamp designed to show how much each coin contains of gold and silver and to serve as a guaranty to public faith.”

Then he explains how the value of metal pieces is changed and depreciated.

“The value of money is depreciated by various causes, either by the change of the name, while the same weight of metal contains a mixture of copper which exceeds the measure desired; or because the weight is wanting, although the mixture has been accomplished in the right proportion; or, what is the worst, because the two vices meet together at the same time. The value of money diminishes of itself by reason of a long service that

uses the metal and diminishes its quantity and this reason suffices to cause to be placed in circulation a new money. This necessity is recognized by an infallible sign, when the money weighs notably less than the money intended to be acquired. It is understood that there results a deterioration of the money."

At the time Copernicus prepared his treatise on the money of the realm for his sovereign liege, King Sigismund, the Polish Kingdom included Thorn, Danzig, and a large part of Prussia. But a portion of Prussia, including Konigsberg, had been erected by the treaty of Cracow, concluded in 1525 between Sigismund, King of Poland, and Albert, Margraf of Brandenburg, into a hereditary fief for the benefit of the latter and his male descendants, which the margraf was to hold of King Sigismund. As by this feudal tenure by Margraf Albert of part of Prussia, subject to the overlordship of the Polish king, the two countries were in a sense one, Copernicus, in his treatise on the money of the realm, expounded to his king what measures were necessary in order to restore stability to the much depreciated Prussian money and then maintain the value of the new money on a parity so that it could circulate both in Poland and Prussia. After pointing out how useless it was to attempt to introduce into circulation by the side of a depreciated currency one of greater value, he

then explained how the introduction of a cheaper measure of value by the side of a higher one would drive the former from circulation. "If it does not do to introduce a new and good money, while the old is bad and continues to circulate, a much greater error is committed by introducing alongside of an old currency, a new currency of less value; this latter does not merely depreciate the old, it drives it away, so to speak, by main force."

Then in answer to the argument that a depreciated currency helps the poor, he says: "We see flourish the countries that possess a good currency, while those that only have a depreciated one, fall into decadence and decline \* \* \* ."

"It is incontestable that the countries that make use of good currency shine in all the arts, have better workmen, and have of everything in abundance. On the contrary, in the States which make use of a degraded money, reigns cowardice, laziness and indolence." In order to remedy the distress to which Prussia had been brought by the falsification and debasement of the currency, and to draw Prussia and Poland closer together by developing their commercial relations, it was necessary to coin two moneys of equal intrinsic value, so that they would circulate concurrently in the two lands. One should bear on one side the royal arms of Poland and on the other those of the Prussian land. The other money should likewise have on



one side the royal arms of Poland, but on the other the imprint of the prince, that is the effigy of the King. "For the first condition to maintain, is that one and the other currency remain under the royal authority, and that they be current and accepted in the whole kingdom by virtue of the prescription of His Majesty; which would be not of a mediocre importance for the conciliation of public opinion and for reciprocal transactions.

"It would be necessary that these two currencies should be of the same degree of fineness, having a similar real value and a similar nominal value, so that, by vigilant care, the State succeeds to maintain perpetually the regulation which it is now question to establish; it does not belong to princes to obtain any profit from the money that they shall coin; they shall add only so much alloy as may be necessary for the difference between the real value and the nominal value to cover the cost of minting, which will avoid the principal attraction to remelt it.

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"It would be necessary, at the time of the emission of the new money, to demonetise the old and forbid entirely its use, allowing it to be exchanged at the mints, in the just proposition of the intrinsic value. Otherwise it would be labor lost to wish to re-establish good money; the confusion that



would ensue would be perhaps even worse than the actual state of affairs. The old money would crush all the advantages of the new."

Then Copernicus explained that gold and silver were the base upon which rested the value of money; and went on to show that in order to maintain them both in circulation the ratio between them must agree with the commercial ratio that existed between them. "It remains," he went on, "for us to expound the manner of the mutual exchange of gold and silver. In order to pass from the class to the kind and from the simple to the composite, it is necessary first to know the price of pure gold to pure silver. It is known that the same exists between pure gold and silver, as between gold and silver minted under the same stamp; as also that the same ratio applies to gold coins and gold bars as to silver coins and silver bars, provided that they have the same proportion of alloy and that they represent the same weight."

As Oresme and Copernicus explained to their royal Masters that by either debasing or raising the coins of the realm disaster and confusion would follow, so also, at the beginning of Queen Elizabeth's reign, one of her merchants, Sir Thomas Gresham, pointed out to his royal Mistress this inflexible unwritten law of money.

Of a Norfolk family, the son of Sir Richard Gresham, who was Lord Mayor of London, Sir

Thomas Gresham was born in that city probably in 1519, and died there on November 21, 1579. He was educated at Cambridge University, was a Protestant, and all his life took an active part in commercial affairs, often representing in the Low Countries the commercial interests of England. In 1566 and 1567 he built the Royal Exchange in London. He founded also Gresham College, and provided that the science of astronomy should be taught there.

In a letter to Queen Elizabeth, which is headed, "information of Sir Thomas Gresham, Mercer, touching the fall of the exchange, MDLVIII," and which begins, "To the Quenes most excellant maiestye," Gresham says:

"Ytt may please your majesty to understande, thatt the firste occasion off the fall of the exchange did growe by the Kinges majesty, your latte ffather, in abasinge his quoyne ffrome vi ounces fine too iii ounces fine. Wheruppon the exchange fell ffrome xxvis. viiid. to xiiis. ivd. which was the occasion thatt all your ffine goold was convayd ought of this your realme."

The works on money of these three men, who, independently of one another, expounded to their respective sovereigns the evils resulting to the State from any attempt to debase the coinage, did not become generally known to their contemporaries. However, their discoveries through

the influence of their royal rulers gradually made some impress upon mankind, and by the end of the seventeenth century it had become common knowledge among the intellectuals of that day. In a pamphlet published in London in 1696, the Law of Oresme, Copernicus and Gresham, though doubtless the writer did not know directly of their works, is thus stated:

“When two sorts of Coin are current in the same nation of like value by denomination but not intrinsically [that is in commercial value], that which has the least value will be current, and the other as much as possible will be hoarded.”

In 1858 the British economist, Henry Dunning MacLeod, called attention to Gresham's statement of this unwritten law of coinage, and suggested that it should be known as Gresham's Law. At the time he did not know of the more elaborate treatises of Oresme and Copernicus on coinage. But when the works on money of those two master economists were revealed through the efforts of Roscher and Wolowski in 1862 and 1864 to the world at large, MacLeod, like a true scholar who wishes to give credit to whom honor is due, suggested that this economic law, a law more powerful than the statutes enacted by the strongest Parliamentary bodies, should be known after all three of its discoverers as the Law of Oresme, Copernicus, and Gresham.

During the centuries, many nations in various parts of the world have had abundant experience to learn the futility of attempting to maintain in circulation as currency two moneys at a ratio different from the market or commercial ratio existing at that time between those two kinds of money. In every case where such an effort has been made, the money that is underrated gradually drives that which is overrated from the country. And this nation has had several experiences with this law. Without touching here upon the works of other economic scholars, such as Petty, Locke, Wolowski, Jevons, Leon Say, Horton, Bamberger, Laughlin, White and others, who have added to our knowledge of the unwritten laws that govern money as the medium of exchange, it can be safely said that the more the economic experience of the human race is studied, the more does it become clear that any attempt to tamper with the currency of a Nation by injecting a debased money into its measure of value is certain to end in disaster through the working of that natural law of finance, the Law of Oresme, Copernicus and Gresham.



















