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D. J. Struik

## THE INFLUENCE OF MERCANTILISM ON COLONIAL SCIENCE IN AMERICA

### I

Settlement of North America was contemporary with the gradual establishment in Western Europe of a mercantile society, in which an early capitalism was developing as the dominant form of economy. Encouraged by the weakening of the Spanish and Portuguese empires, and growing in power at home, influential sections of the *haute bourgeoisie* became engaged in the chartering of monopolies for trade overseas. Often the crown itself was interested, and so were those feudal lords who were willing to stoop from land to money. And it occurred to the shareholders in these monopolies that their purpose could best be served by the settling of colonies.

Once a colony was established, on the St. Lawrence, the New England coast, on the Hudson river or in Virginia, trade could flourish through fisheries, trapping, the growing of cash crops and the cutting of timber, and perhaps mining. The weakened condition of the once flowering African countries made it possible to introduce Negro slaves where Indians were driven out. Another source of labour were indentured white servants. There was also free labour, especially in the Northern colonies, and in the cities were craftsmen and artisans. Along the coast ship-building developed. Those Europeans who survived the first agonies of snow, scurvy, starvation and warfare were a sturdy lot, often led by highly intelligent and cultured men. They succeeded in building stable social structures in close imitation of their homeland, with those changes which the conditions of the new country imposed.

The growth of the settlements was unequal. The British colonies, based on agriculture and shipping and the destruction of the Indians, grew as a rule much faster and were more stable than the French colonies, mainly based on the fur trade (in which the Indians functioned as despised partners). Towns of considerable importance developed,

such as Quebec, Boston, Newport, New York, Philadelphia, Charleston, but even at the end of the XVIIIth century an estimated nine tenth of the population was engaged in agriculture, accompanied by fur trade on the frontier. The bulk of the products, fur, grains, tobacco, or cattle was for the local as well as the European market. Whether you were an Indian on the frontier, a corn or hog raiser on the Connecticut, a planter in Virginia or even a Spanish rancher on the Rio Grande, you worked for the sale of your products. The wealthy merchant in the coastal town traded in the commodities of the whole world, not excepted human beings. A favorite sport was land speculation.

At first, foreign trade and colonization in England, France and Holland was carried out by private monopolies chartered by the state. With the consolidation of the states into powerful bureaucratic organisms, maintained by systematic taxation, these states began themselves to assume the character of monopolies intent on squeezing each other from the markets of the world. Trade policies became of paramount importance. In this system of competing bureaucratic states, run by moneyed interests, already honeycombed with capitalistic elements, much of the directness of personal relationships, typical of the feudal period, was lost. An abstract theory of mercantile enterprise began to crystalize, political economy and statistics were born and with it mercantilism developed as a theory and as a practice.

Not only in the sphere of trade policies and industrial enterprise abstract relationships tended to supersede direct personal contact. Warfare, from the point of view of statesmanship, became more and more an almost impersonal factor in the whole game of empire building. The science of nature, encouraged by the mercantile classes, became also more abstract and impersonal. The ancient teleology made room for causality, emphasis on quality gave way to emphasis on quantity, and the pure description of living things was replaced by more rigorous classification. Instead of the speculative philosophy of the ancient masters came the precision of mathematics, and with it a mechanical description of nature.

## II

The mercantilist policy, which became the guiding light of the European statesmen of this period, was based, in the main, on the acquisition of bullion by trade. To reach this goal more had to be sold abroad than imported, and this could be obtained by the expansion of foreign trade. This foreign trade led to the so-called "balance of trade", which dominated economic thinking. The best export was that of manufactured goods, the best import that of raw materials since such import

had the effect of stimulating home manufactures and with this again export.

This emphasis of trade over manufacture, this method of considering industries primarily as a means of obtaining bullion through mercantile activity was indicative of the rudimentary stage of industry even in the countries with the most advanced capitalism. As William Petty wrote in the XVIIth century: "There is more to be gained by Manufacture than by Husbandry, and by Merchandise more than by Manufacture". Industrial production was seen as a necessity for the circulation of goods rather than, as in the fully developed capitalism of later days, circulation as a necessity for the production of goods.

Colonies, in the eye of the "mother" country, thus existed for one purpose only, and that was as sources of raw material to advance the balance of trade. If gold and silver could not be pressed immediately out of the soil or of the native population, then other metals, or furs, or timber, or staples like tobacco, indigo and fish had to take their place. Whatever might have been the personal motives of the actual colonial founders, whether pirates, merchants, or religious leaders, they were hardly material to the policy makers at home, or at most of secondary importance as long as the revenue came in. A whole series of measures attempted prevention of the growth of colonial manufactures, another series encouraged the output of raw materials and the channeling of the export and import into the ships and ports of the mother country. It is amazing to discover how many manufactures still managed to exist under colonial rule, especially in Pennsylvania.

### III

The science of the mercantilist epoch reflects in form and content the dominant traits of its economy and the attitude of the *haute bourgeoisie*, the merchant patriciate and those feudal, absolutist and clerical elements which were willing to support mercantilism. This new class, full of confidence, looked to science for support in its quest for the domination of nature and the promotion of invention useful for its ends. This new science was based on the new mechanical philosophy, and this again was based on mathematics.

The main participating countries were England, France and Holland, where the new commercial-capitalist classes were able to struggle for a dominant position. Since they were also the main colonizing countries in Eastern North America, the influence of the new philosophy can also be traced here, if only with a lag in intensity. In the leading countries whole new sciences sprang into being, and others like astronomy were fundamentally changed. In the wake of this transformation, but more slowly and weaker in its revolutionary effect, came a new flowering

of the sciences connected with minerals, animals and plants, as well as anatomy and medicine.

Much of this scientific development was stimulated by the necessities of foreign trade. Since shipping constituted the very backbone of this trade, we see exceptional attention paid to the sciences and techniques which bear on transoceanic navigation, or which are influenced by it in their turn. Thus we find a deep interest paid to astronomy, mechanics, calculus, certain branches of physics such as optics and magnetism, to cartography and instrument making. This is, of course, not to say that the requirements of navigation were the only, or even the principal, factors stimulating the exact sciences during this era. We have already observed how quantitative thinking permeated the whole of "natural philosophy". But whenever we look into the motives of the scientists and those of the princes and other magistrates who patronized their work, we find great attention paid to the needs of navigation in peace and war. We need only think of the foundation of Greenwich observatory in 1676 and the observatory at Paris (1666—71), of the experiments of Huygens on pendulum clocks, or of sections of Newton's *Principia*, to see the influence of the needs of navigation on scientific endeavour.

It was also quite natural in a system which demanded the production of raw materials in foreign countries that natural history began to flourish. Although the accounts of the travellers often expressed the amazement of the authors at seeing bison, humming birds (colibris), rattlesnakes or cactus, they always stressed the utilitarian aspect of their discoveries. Even a purely scientific characterization of a plant or animal seldom omits the use or potential use of its object. The settlers themselves did not only look for useful native plants or animals, but also imported those of Europe and Asia which might thrive in their part of the New World. The naturalists of those days were never very far from the farm, the hunt, or the garden.

Utilitarian science, however, cannot stand on its own legs without deteriorating. It has to branch out into domains where usefulness becomes secondary and finally immaterial. The scientific mind begins to desire understanding for its own sake, and its instinct is healthy, since only in this way can deeper levels of truth be reached. Nautics and geography need theoretical mathematics, optics and astronomy. Agriculture and stock-breeding also need disinterested research, to which gardening adds its own share.

This trend can lead to great achievements when there exists a ruling class master of sufficient surplus and leisure to cultivate the sciences for their own sake and to establish academies and gardens staffed with expert men of science. Such conditions were eminently realized in the Europe of the colonizing period, and also began to prevail in such cities as Philadelphia and Boston. Wealthy amateurs, virtuosi and academic-

ians vied with philosophers and instrument makers in attacking nature's secrets. Yet, despite all this search for knowledge, mercantilist science never for long lost sight of its practical aspects, especially in the colonies. In some way or another we are always aware of the balance of trade behind the science of the period.

#### IV

When we study colonial science we are struck by its dependence on the home country, be it France, Great Britain or Spain, as well as by the accuracy in which it fits into the rather narrow frame into which we have tried to place mercantilist science. Science in Europe, growing out of medieval and ancient theories and practices under a host of different national, philosophical and religious traditions, had many facets which for their understanding need more than an economic formula alone. The formula, however, appears sufficient to grasp the character of most colonial science. A considerable amount of it can be classified as "Newtonian" and "Linnaean", notably in the XVIIIth century, although the work of the geographers and the plant collectors of the previous century leads up to it. XVIIIth century astronomers in America lived and died with their Newton, and those working in natural history knew no greater glory than recognition by the sage of Uppsala.

This stress on Newtonian and Linnaean science did not exclude a more general curiosity, especially among the Philadelphian emulators of the virtuosi of the Royal Society, nor did it exclude special studies of physicians educated in the schools of Boerhaave or Cullen. However, when we think of colonial science in North America the first names that come to mind may well be Franklin, Rittenhouse, Winthrop, Sarrazin, Garden, Bartram or Kino, and the only one of them whose work transcends the "Newtonian" or "Linnaean" pattern is that of Franklin, whose work on static electricity began to pass beyond the orthodox mercantilist frame.

The dependence of colonial science on Europe was due to the relative simplicity of colonial life, where even the wealthy were not too far removed from the direct struggle with nature, the relative smallness of the leisured classes and the fact that science in Europe moved so fast that few men in the colonies could keep up with it, especially in mathematics and mechanics. The initiative usually came from those Europeans who had an interest in America, like members of the Royal Society or the Académie des Sciences (and, in the Alaska region, the St. Petersburg Academy). Even in the case of Franklin's work on electricity, the only major field where America laid down the law to the Europeans, the first stimulation came from Peter Collinson in London. The great geographical explorations of Cortès, Marquette, La Salle,

Kino, Hearne, Vancouver and others were under European auspices, the naturalists were often Europeans on a travelling assignment, as Hernandez, Catesby or Kalm, or had commissions to collect for European gardeners, as had the Bartrams. The leading physicians had their degree from a European university, even after the foundation of the Philadelphia medical school in 1762.

Inside the limitations imposed by their colonial status the achievements of the American scientists were considerable, and deserved the appreciation received from Paris, London, Leiden or Uppsala. The cartographic work of a Franquelin or Evans, the astronomical observations of a Winthrop or Rittenhouse, the paleontological discoveries of a Longueil or Croughan, the botanical collections of Clayton or the Bartrams, the medical councils of a Morgan or Rush, not to speak of the stimulation radiating from Franklin, compare well with that of distinguished contemporaries in Europe.

During the XVIIth century a few institutions of higher learning had been created. The Jesuit college at Quebec and the Puritan college at Cambridge (Harvard), both founded in 1635—36, joined the already well established universities of Mexico and Lima. William and Mary College in Virginia dates from 1692. To these colleges were added, in the XVIIIth century colonial days, Yale at New Haven (1700), the colleges at Princeton (1746) and Philadelphia (1749), King's College in New York (1754, now Columbia University) and some others. All these colleges taught some science. In loose contact with them were a number of amateur astronomers and botanists, cartographers and explorers, surveyors and navigators, experimenters in electricity, instrument makers, physicians and scientifically inclined theologians such as the Mathers in Boston. In and around Philadelphia they found their center in the American Philosophical Society, founded in 1743, followed by the American Academy of Arts and Sciences in Boston (1780). The transit of Venus of 1769 showed that those who practised astronomy were able to enter into a close collaboration with each other and with European scientists.

## V

The scientific activities of the Americans fitted into that general pattern which gradually became more visible when the XVIIIth century grew older, and which we can call the emergence of American nationalism. The activities of the astronomers, botanists, geographers and horticulturists passed beyond the narrow limits set by the particular colonies. Easier travelling, greater educational facilities, an intercolonial postal system made communications easier. When the Philadelphians

decided to found a scientific society, they did not call it the Pennsylvanian, but the American Philosophical Society. Not only in their political activity, but also in their scientific interests Franklin, Jefferson and Washington were not provincials, but "Americans" and as such they were members of the international republic of arts and letters. We can detect a similar trend in the Spanish and in the French speaking sections of the New World. We recognize a characteristic typical of many later anti-colonialist struggles, in which the XVIIIth century America set the pace for much which is happening today in other parts of the world.