

# Adam Smith's Methodology and the Legacy of Newtonianism in 18th Century Scotland

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This paper will examine the methodology of Adam Smith and compare it with that of Newtonians. The methodological tool of establishing the central category of Smithian economics was not "experimental method" as Scottish Newtonians acclaimed as the true method of sciences, but a way of deductive reasoning. In this respect, Smith was not a Newtonian at all. But it is also true that Smithian political economy has developed in the context of Scottish scientific culture, especially of Newtonianism. Therefore, though not exactly a product of Newtonian methodology of the time, it is not an exaggeration to say that Smithian system of social sciences was a by-product of the developments of the 18th century sciences.

## (1) Introduction : The Newton in moral science

Political economy in 18th century Scotland has its origin in the complex nature of Scottish culture of the age. One of the contexts within which it emerged was the remarkable development of Scottish science. It is natural, therefore, to look for the influence of natural science upon the development of it.<sup>1)</sup> Most of the arguments so far have been made on the relation between Newton and Smith. However, premature judgements often tend to conceal complicated textures of historical processes. A historian's task is to untie the entangled strings in order to bring real connections to light.

The economic theory of Adam Smith often has been characterized as an adaptation of Newtonianism in social sciences. It is the common knowledge of the contempo-

rary historians of economics that, when constructing his system of economic theory, Smith took Newtonian theory of planetary system as the model.<sup>2)</sup> In their arguments, the regulating principle of natural price in his theory had the same explanatory role as the concept of gravitation had in Newtonian system.

This view has been prompted by the fact that he made an intensive research on the history of astronomy and discussed the development of the science from the ancient to Newton according to his methodological viewpoint. For example, Phyllis Deane stated in her history of economics that Smith adapted Newtonian world view.

"There was a systematic, god-given harmony in the operations of the universe and that task of the social scientist investigating a discrete section or sub-system of it was to identify the fundamentally simple

axioms and laws on which it hinged, to classify the strategic variables which set in motion and to analyze the structural relationships of cause and effect which gave that particular system its coherence and predictability.”<sup>3)</sup>

The contemporaries of Smith looked his major achievement under the same light. John Millar called him “the Newton” in moral sciences and Dugald Stewart praised the superiority of Smith’s achievement as a work of science.

“It may be doubted, with respect to Mr. Smith’s *Inquiry*, if there exists any book beyond the circle of the mathematical and physical sciences, which is at once so agreeable in its arrangement to the rules of a sound logic, and so accessible to the examination of ordinary readers do not know that, upon any subject whatever, a work has been produced in our times, containing so methodical, so comprehensive, and so judicious a digest of all the most profound and enlightened philosophy of the age.”<sup>4)</sup>

Confusions will arise, however, when one reads Smith’s writings on methodology, expecting to find evidences pointing to the fact that Smith imitated Newton. Smith’s interpretation of Newtonian method was very peculiar. Strangely enough, he once said in *The Lectures in Rhetoric and Belles Lettres* that Newtonian method was to “lay down certain principles known or proved in the beginning, from

whence we account for the severall Phenomena, connecting all together by the same Chain.” Furthermore, he stated that “Des-Cartes was in reality the first who attempted this method.”<sup>5)</sup>

Smith made a duplicated mistake in this explanation. Firstly, Descartes was the target that Newton’s criticism aimed at in his *Principia*. There are numerous attacks on Cartesian philosophy in the writings of British Newtonians and most of them accused him of employing the false method in empirical sciences, the very method that Smith called Newtonian in the lectures, that is, the method of deductive reasoning. Therefore, Newtonian method and Cartesian method is not at all identical as Smith explained above.

Secondly, the method Smith described as to “lay down certain principles known or proved in the beginning, from whence we account for the severall Phenomena, connecting all together by the same Chain” should have been called Aristotelian method, the method of individual sciences described in Aristotle’s *Posterior Analytics*, instead of Newtonian method. He took geometry as the model of this method.<sup>6)</sup> It is true that, at the time of Adam Smith, Aristotle was regarded as the father of the false method of scholastic philosophy and substantial parts of his theories were ignored in the teachings of Scottish universities.<sup>7)</sup> But it is also true that, as Thomas Reid explained in the following passage, the characteristics of his method in the

book were known to Smith's contemporaries, therefore no justification can be given to Smith's ignorance.

"When the premises are certain, and the conclusion drawn from them in due form, this is demonstration, and produces science."<sup>8)</sup>

"All demonstration must be built upon principles already known; and these upon others of the same kind; until we come at last to first principles, which neither can be demonstrated, nor need to be, being evident of themselves."<sup>9)</sup>

Not praising Aristotle of finding the proper way of presenting scientific reasoning, Smith criticised 'Aristotelian method', that is, the method of the composition of scientific writings based upon the artificial classifications of subjects, for the reason that it had no logical coherence.<sup>10)</sup>

The eccentricity of Smith's explanation of the term 'Newtonian method' presented in the lectures implies something about his attitude toward Newtonianism. Apart from the passage analyzed above, he mentioned nothing on Newtonian method that described by Newton in *Opticks*, that is, the method of analysis and synthesis,<sup>11)</sup> though this method was taught at the lectures on logic of Scottish universities as the true method of empirical sciences.<sup>12)</sup> Furthermore, there is no sentence in the whole of Smith's writings similar to the simple statement that he would adapt

experimental method in moral science, as David Hume did in his *Treatise*.

Indeed, several historians of economics seem to agree that Smithian methodology can be described, not as a single and coherent method, but as the compound mixture of heterogeneous methods that sometimes contradict with each other. Terrence Hutchison has once characterized his method as comprehensive, comparing the development of political economy after Smith, mainly promoted by David Ricardo.

"Smith was methodologically comprehensive... the student of society, or of economy, cannot afford to overlook any method by which some grain of truth, however insubstantial and fragmentary, may be picked up."<sup>13)</sup>

"It is a tribute to the remarkable balance which Smith achieved that he has been both acclaimed, and criticised from both or all sides in subsequent 'methodological debates.'<sup>14)</sup>

Richard Olson has argued that Smith's system was built upon the different traditions of early modern social sciences, the method of historical inquiry and psychological reasoning, therefore it had inconsistencies and contradictions in itself.<sup>15)</sup> These arguments suggest that the origin of Smithian methodology cannot be treated single-handedly, such as, if any, the introduction of Newtonian astronomy or Baconian empiricism into moral sciences. Instead,

Smithian social sciences should be placed in the multiple contexts of Scottish Newtonianism and of the scientific culture of the century.

## (2) In the Context of Scottish Newtonianism

Although few attempts have been made yet to bring light on the role of Newtonianism in the Scottish Enlightenment, it is certain that Newtonianism was one of the fundamental elements of 18<sup>th</sup> century Scottish high culture. As several historians of Scottish science have described, the introduction of Newtonianism into the country's educational institutions was very early, compared to their counterparts in continental countries.<sup>16)</sup> This was done by ruling elite, mostly for two reasons; the one is, understandably, the demand to catch up to England in science and technology. The other is more typically an 18<sup>th</sup> century phenomenon, the ideological necessity to fight with so-called 'atheism' and 'enthusiasm'.

According to its advocates' views in the beginning of the century, Newtonianism was the efficient weapon to demolish the doctrines of 'atheists' like Descartes and Hobbes, though obviously they were not, as well as to reduce 'enthusiasts' to silence. In reality, It was the means for the moderate faction of ruling elite in England, to cut the 'middle way' through fierce ideological conflicts seen so often in the 17<sup>th</sup> century, even if it might not have supplied the emer-

ging 'bourgeoisie' the justification of their power, as Margaret C. Jacob once suggested.<sup>17)</sup> In the context of 18<sup>th</sup> century Scottish history, it was also a strong ideological measure to calm the nerves of middling ranks and to direct their attentions to 'refinement and improvement', rather than to dissidence and revolt against the union.

18<sup>th</sup> century Scotland was certainly a rich hinterland of Newtonianism. Several of Newton's closest alleys come from Scottish-Oxford connections, such as David Gregory and John Keil. Newton himself was active in the execution of the strategy in the country. He put Colin MacLaurin, an excellent interpreter of his doctrines and the most important mathematician after him in 18<sup>th</sup> century Britain, in the chair of the natural philosophy of Edinburgh University. Not only writing one of the most important text books of Newtonian natural philosophy, MacLaurin eventually created the Philosophical Society of Edinburgh, one of the organs to promote 'new science' in the country.<sup>18)</sup> With his masterpiece as a mathematician, *A Treatise of Fluxions*,<sup>19)</sup> MacLaurin became the vanguard in the battle fought between Newtonians and George Berkeley, who attacked Newtonian analysis by publishing *The Analysts*.<sup>20)</sup> Other prominent mathematicians in the country, like John Steuart in Aberdeen and Robert Simson in Glasgow, worked in close connections with his circle in London, too.<sup>21)</sup>

Newton had a crucial role in developing Newtonianism theoretically, too. He left a paragraph in his widely read *Opticks*, which strongly suggested that natural theology and other moral sciences could be reformed by his scientific method.<sup>22)</sup> Consequently by the second quarter of the century, Newtonianism had already become an intellectual establishment in the country.<sup>23)</sup> Natural theology of Newton's friends, especially of Samuel Clarke, was discussed among young intellectuals in Scotland and served as the catalyst of the moral philosophy of the Enlightenment in the country.<sup>24)</sup> Moreover, beyond the suggestion of Newton, there were several attempts to apply Newtonian method to moral sciences. Abadonian philosophers, particularly George Turnbull and Thomas Reid, very consciously tried to accomplish this project.<sup>25)</sup>

However, Newtonian influence in Scotland is not limited to the lineage directly derived from Newton in London. There were several kinds of Newtonianism and two major strands are worth mentioned here. The one is the Dutch version of Newtonianism. The medicine and the chemistry of Netherlands had long been influential upon British sciences through medical education given to British over-sea students in Leiden. Scotland had very close commercial ties with this country, too. Through these channels, both academic and commercial, the theories of Boerhaave and other continental scientists, who had

adapted Newtonian ideas in their own particular ways, incorporated in Scottish medical teaching.<sup>26)</sup>

The other Newtonianism came from France. Newtonian ideas in the country was different from original doctrines that had developed in London, for French consulted Descartes and Leibnitz, Newton's enemies, in order to interpret Newtonian natural philosophy.<sup>27)</sup> There was also a built-in deist tendency in continental Newtonianism. Scots read and discussed French Newtonian publications, both of Voltaire, the older generation, and of Buffon, the new generation.<sup>28)</sup> Once bearing in mind the diversity and the richness of historical contexts, it is too simplistic to say, "Smith was influenced by Newton."

#### Thomas Reid

To clarify Smith's methodological position in the Scottish scientific culture related to Newtonianism, it is useful to contrast Smith's methodology with those of philosophers who had the same perspective concerning empirical sciences as Scottish Newtonians'. Thomas Reid belongs to Gregory family that represented the Newtonianism of Newton's circle in Scotland. He showed the detailed knowledge of natural sciences in his lectures on natural philosophy.<sup>29)</sup> Unlike Adam Smith, who showed the peculiar understanding of Newtonian method, Reid's interpretation of Newtonian method was identical with that of MacLaurin and Henry Pemberton.<sup>30)</sup>

“Sir Isaac Newton’s method of philosophizing thus laid down in his *Opticks*, by way of analysis ought to proceed the method of composition. This analysis consists in making experiments and observations, and in deriving general conclusions from them by induction and admitting of no objections against the conclusions but such as taken from experiments to synthesis.

In experimental philosophy, propositions collected from the phenomena by induction are to be deemed notwithstanding contrary hypothesis, either accurate or very nearly true, till other phenomena occur by which they may be rendered more accurate or less liable to exceptions.”<sup>31)</sup>

He stated several times in his writings that the method of natural sciences could be introduced to moral sciences, especially to political philosophy.<sup>32)</sup> On the other hand, he was very critical to the attempts to introduce mathematical or deductive method to other sciences. Empirical sciences like physics were the sciences of probability, because no certain knowledge could be attained by empirical investigations, which was the sole means of studying objective reality.

“The mathematicians, who never taught of applying syllogisms to their science are notable instances of this reasoning.”

“Mathematics afford the best evidence of the latter kind [demonstrative reasoning], where, from a few axioms long trains of

reasoning are carried on, all the links of which are necessarily connected with one another.”<sup>33)</sup>

To this school of Newtonians, mathematics is the science that was characterized by its ability to attain the certainty of knowledge, because its subjects, line, number, etc., were the products of human imagination, whereas empirical sciences were the sciences of probability.<sup>34)</sup>

“It has been disputed whether demonstrative evidence can be applied to any of subject other than mathematics. For my part I don’t think I can, probable evidence arises from a sum of arguments each of which has some weight.

Another difference is, the demonstrative evidence admits of no degrees, whereas probable evidence admits of all degrees.”<sup>35)</sup>

Reid also gave warnings against the use of analogy and of the principle of ‘Okham’s razor’ that Smith regarded as the rules of selecting first axioms in his “History of Astronomy.” He strongly insisted that the first principles had to be verified only by careful experiments. They must not have been taken for granted as true on the grounds that they looked self-evidently true or very familiar to human experience.<sup>36)</sup> His lecture notes on political economy, taught just after he succeeded Smith’s chair at Glasgow University, showed reservations on the Smithian theory of natural price.<sup>37)</sup> Obviously noticing

Smith's theory of market mechanism, he seemed to prefer more empiricist ways of reasoning in political economy to Smith's method, such as James Steuart's the *Principles of Political Economy*, soon to be published, would advocate.<sup>38)</sup>

It is doubtful that Smith had the belief that there were several methods in individual sciences and they were fundamentally different from each other. Nor it is likely that Smith regarded the method of mathematics, deductive reasoning, was not applicable to empirical sciences, such as political economy. Coincided with his statement on Newtonian method in *The Lectures in Rhetoric and Belles Lettres*, the methodology of Smith indirectly outlined in "The History of Astronomy" was his version of Aristotelian method, modified by an empiricist viewpoint and Humean psychology. It can be summarized as follows: building a system of deductive reasoning from certain principles that is as simple as possible and familiar to human experience, with the view to explain previously unknown phenomena. Although experience was certainly indispensable to his methodology, it was not the one and the only means to disclose objective reality. On the contrary, Smith thought imagination, the very function Reid regarded as the origin of errors in philosophy, was necessary to every theoretical reasoning.

In fact, the methodological tool to establish the central categories of Smithian economics, such as natural price, was not

'experimental method', which Scottish Newtonians acclaimed as the only legitimate method in empirical sciences, but a way of deductive reasoning, as Dugald Stewart reported later.

"The influence of his early taste for the Greek geometry may be remarked in the elementary clearness and fullness, bordering sometimes upon prolixity, which he frequently states his political writings."<sup>39)</sup>

Geometrical reasoning was typically crystallized in Euclid's *Elements*, which Robert Simson, his teacher of mathematics at Glasgow University, repeatedly insisted to be the ideal method of theoretical sciences.<sup>40)</sup> The origin of Smith's Aristotelian method can also be traced back to his text book of logic at Glasgow University, *The Art of Thinking*, that was widely used for centuries, written by Arnauld and Nicole, prominent Cartesians.<sup>41)</sup>

The methodology employed in *The Wealth of Nations* has no resemblance to that of Newtonian science<sup>42)</sup> except the fact that, as several authors who tried to describe him as a Newtonian pointed out, he consciously had constructed his system deductively from the first and self-evident principle, such as the propensity to exchange or the function of sympathy. It looks as if Smith had followed Newton in the first two of the rules of the philosophizing of *Principia*, the parsimonious principles that requires axiomatic principles should be few in number, but not in the

second two, the needs of experimental proofs in theoretical reasoning.<sup>43)</sup> Concerning the method outlined in *Opticks*, their differences are more obvious. Whereas Reid reiterated the thesis that the method of analysis, experimental investigation and verification, had to precede the method of synthesis, the construction of system with deduction, Smith only used the method of synthesis and there is no reference in the whole of his writings to the method of analysis presented in *Opticks*.

Dugald Stewart admitted that Smith's superiority in *The Wealth of Nations* was not in its scientific novelty, but in the way of presenting its basic ideas systematically.

"After all, perhaps the merit of such a work as Mr. Smith's is to be estimated less from the novelty of the principles it contains, than from the reasonings employed to support these principles, and from the scientific manner in which they are unfolded in their proper order and connection."<sup>44)</sup>

In another word, not in his methodology in investigation, but in his rhetorical skills in writing, that is, in 'Newtonian method' in rhetoric just as Smith described in his lectures. In these respects, Smith was not a Newtonian at all.

### (3) Smith's Newtonianism

So far, it seems that Smith developed his methodology from the curious combination of the old tradition of scholastic learn-

ing, Cartesian logic and the Humian psychology of imagination in *A Treatise on Human Nature*, rather than transplanted it from contemporary natural sciences. But this is again oversimplifying the matter that embedded in rich historical contexts.

Biographically, the relation between Smith and early Newtonians is full of ambiguity. Smith must have learned Newtonian natural philosophy at Glasgow University. His teacher was Robert Dick, rather an obscure figure, known as a good teacher who taught Newtonian natural philosophy at the university.<sup>45)</sup> It is not certain, though, that Dick's teaching at the university was similar to that of MacLaurin at Edinburgh University. Later John Robison, one of his prominent student and an empiricist physicist, wrote that Joseph Black, another prominent student of Dick, persuaded him to get rid of Dick's influence and to follow Newtonian method with strong empiricist emphasis.<sup>46)</sup> Although Robison's picture of Black as a strict empiricist like himself might not be true,<sup>47)</sup> it is likely that Dick's influence upon his students was not in accordance with the view of empiricist Newtonianism represented by MacLaurin.

Likewise, it is doubtful that Smith's experience as a student at Oxford, the Mecca of astronomy, had something to do with his views on natural philosophy. Having returned to Scotland, his critical opinion upon British Newtonians was explicitly presented in his letter to *The*



*Edinburgh Review*, although it is not difficult to suppose that he used their books in order to enrich his knowledge of astronomy beyond the limit of his education at Glasgow.<sup>48)</sup>

"There is not only no tolerable system of natural philosophy in the English language, but there is not even any tolerable system of any part of it. The Latin treatises of Keil and Gregory, two Scotsmen, upon principles of mechanics and astronomy, may be regarded as the best things that have been written in this way by any native of great Britain, tho' in many respects confused, inaccurate and superficial."<sup>49)</sup>

While he praised James Bradley, another Oxford astronomer, saying he was "almost the only person now remaining in England to put us in mind of their illustrious predecessors," there is no evidence that Smith attended Bradley's lectures taught when he was in Oxford.<sup>50)</sup>

Not surprisingly, Smith's interpretation of scientific method is similar to that of French Newtonians, for example, of Abe de Condillac, whose understanding of Newtonian method, analysis and synthesis, was parallel to Smith's idea of Newtonian method.<sup>51)</sup> Both Arnauld and Nicole, Cartesians, and Condillac, a Newtonian, shared the same notion on the method of analysis. They regarded the method as the procedure of breaking down compound thoughts, into general concepts in the case of the former, or into sense-data in the case of the

latter. Therefore, analysis and synthesis were identical in the sense that both were logical and mental processes, only differed with each other because the latter was the reversed process of the former.

By contrast, for Newton, MacLaurin and Reid, analysis in an empirical science was the inductive and experimental process to disclose the general laws of nature, therefore qualitatively different from synthesis, a logical process, and mathematico-deductive reasoning as well in the case of *Principia*, Which had to be conducted to build an explanatory body of science. In order to guarantee the empirical nature of a science, it was methodologically crucial for them to insist the proposition that analysis had to be completed before synthesis began. The proposition was also important to give legitimacy to Newton's concept of gravitation, for Cartesians and Leibnitz criticised the concept because of Newton's failure in explaining the cause of it. If the law of gravitation was established by the method of analysis, it could be regarded one of proper laws in natural philosophy, although it could not escape the disgrace to be called an 'occult quality' by continental philosophers.

Not to mention French Cartesians, both Condillac and Smith felt no need to reiterate the importance of analysis as the experimental process. It was useless for them to describe these two processes distinctively, for the one was differed from the other only in order.<sup>52)</sup> If Smith had the same

interpretation of Newtonian method as Condillac had, there is no wonder that he did not employ the words “analysis and synthesis” when he discussed the method of science. In addition, Smith thought that the explanatory systems of sciences became simpler as the progress of human knowledge, therefore became easier to understand. This is one of points that Condillac made in his *Traité des Systèmes*.<sup>53)</sup>

At least one thing is clear from these evidences. Smith did not identify himself with early British Newtonians, such as Keil or MacLaurin, like Thomas Reid did. Although there is no concrete evidence available, it is not likely that, after taught by Robert Simson and Robert Dick at Glasgow University, he picked up several components of Continental Newtonianism through his reading in solitude.

#### New development in Scottish Science

There is also a possibility that Smith was in the same direction in which contemporary Scottish sciences were developing from the middle of the century. In this context, Smith's ‘Newtonianism’ can be described in the following two aspects. Firstly, the way of constructing an ‘imaginative machine’ to explain the phenomena of nature upon the foundation of ‘observation and experiment’. In other words, the method of building individual sciences as derived from certain empirical principles. Secondly, the metaphor of self-regulating mechanism embedded in natural or artifi-

cial system, which have the active property of their elements as their bases. This attribute of elements makes sharp contrast to the passive and inactive nature of bodies in the mechanistic image of the world held by early Newtonians.

Smith's fellow scientists in Scotland constructed natural sciences that were to explain natural phenomena from certain empirical principles, for instance, the nerve system of William Cullen, the heat of Joseph Black and James Hutton. They were supposed to supply the fundamental laws of the parts of nature. Like the law of universal gravitation, these principles could not be deduced from more abstract laws, but simply supposed to be existing on the grounds that they were found by ‘observation and experiment’. These developments of natural sciences occurred within the formats of old Newtonianism, but soon stepped out of its boundary.

In the middle of the century, Lord Kames, one of their common friends, tried to rehabilitate the idea of power contained in physical bodies.<sup>54)</sup> This notion was once suggested by John Toland and severely denounced by Newtonians like Samuel Clarke. Although Kames' paper on the laws of motion, which published in the journal of Edinburgh Philosophical Society, was scientifically a failure, it is certain that he represented a new feeling towards the universe and God, embraced by some Scottish and continental intellectuals alike. This idea supplied the means to describe

nature as a self-regulating mechanism, as most dramatically done by D'Holbach in his *Système de la nature*. Employing still the vocabulary of Newtonians, Cullen and Black put active principles into their systems and built their physiology and chemistry as independent disciplines from mechanical physics.<sup>55)</sup>

The way in which Smith presented his systems on ethics, Jurisprudence and political economy was similar to those of Scottish scientists. He began his systems with some given 'principles' that were justified as self-evidently true by daily experience of human race, without going back to, or deducing them from, certain general philosophical notions seen as universal truths. Then he constructed the whole of his systems deductively from them, adding necessarily modifications with the help of empirical data collected from many examples. Along with his fellow scientists, Smith had no intention to design the complete explanatory body of the world, as Descartes and Leibnitz did. He only created several individual theories belonged to different disciplines and all of them supposed to be founded on 'experience' rather than on 'speculation'. There was no abstract principles in his systems like 'cogito' or 'the principle of sufficient reason', and his 'principles' differed according to the phenomena to which they had to explain.

The difference between Smith and his fellow scientists lies in the nature of the

axiomatic presuppositions of their systems. Whereas natural scientists, thanks to already collected data in their disciplines for centuries, could present their principles as legitimately derived from 'experiments' as Newtonian method required, even though sometimes they were not in reality, it was absolutely impossible for Smith to pretend to have verified them by 'experiments'. Statistics and mathematics needed to build an empirical sciences like physics in political economy only was able to develop fully in the middle of the 20<sup>th</sup> century. Therefore, it was justifiable for Smith, away from Newtonian traditions in natural sciences, to create his system in political economy upon several 'self-evident' axioms that were only based upon the observations of daily experience. For more empiricist political economists, James Stueart for example, systems never became logically consistent and easy to grasp, or could not be completed at all.

Moreover, there is evidence that Smith's image of self-regulating market has something in common with these new sciences. The following paragraph of William Cullen disclosed the same inspiration that Smith embraced in *The Wealth of Nations* when he criticised Francois Quesnay. Smith emphasized the spontaneous power of the societal body to correct misjudgments of governing elite and considered this ability as the essential property of a society parallel to that of natural body.<sup>56)</sup> So did Cullen on natural body in

his lectures on physiology, too.

“The animal economy has powers in itself, and, in consequence of its own peculiar constitution, resists and obviates various injuries, and not only so as to prevent their effects, but that when these are produced, the constitution remedies these very evils, and restores health.”<sup>57)</sup>

“This constitution of the animal economy, we call NATURE.”<sup>58)</sup>

Here the similarity between Smith's view and natural scientists' is more obvious, because what matters is not the adaptation of method, but the use of metaphor in science.

#### Natural history

Furthermore, along with various Newtonianisms, there is another context of scientific thoughts in the 18<sup>th</sup> century that might have had an influence upon Smithian social sciences. David Lieberman persuasively showed that his theory of natural Jurisprudence was based upon an eclectic method, which incorporated deductive reasoning and the method of natural history.<sup>59)</sup> So in *The Wealth of Nations*, as Terence Hutchison described. This empiricist aspect of Smith's method cannot be overlooked, though it is not so impressively presented in his works as Colin MacLaurin and Thomas Reid did in their methodological manifestos.

When once compared, not with his con-

temporaries, but with the political economists of next generation, such as James Mill and David Ricardo, Smith had certainly a strong empiricist inclination in his researches. As Paul Wood has once pointed out, natural history was another source of influence that natural sciences had on 18<sup>th</sup> century social sciences and much more so on Scottish social sciences.<sup>60)</sup>

Thus it is misleading to say that entire Smithian system was built upon the revised edition of Aristotelian method in *Posterior Analytics*. It is more likely that Smith's methodology was a hybrid of Aristotelian method and the method of natural history in the following way:

Instead of demonstrating theorems from axiomatic propositions, natural history collects data and classifies them. For Smith, it is the supplementary method to his deductive reasoning, for he presupposed certain principles as true, such as sympathy and natural price, before the inductive processes began. Allowing the universality of the results of deductive reasoning from supposed general principles, natural history served his theories as the supplementary explanatory tool to justify the deviations of existing systems from general laws, finding particular conditions derived from geographical, historical and situational contingencies.

#### History of astronomy

Placed within the above-mentioned contexts of scientific culture, the study con-

ducted in his "The History of Astronomy" seems to have contributed to the formation of Smith's scientific method in the following ways. Firstly, with the help of Humian theory of imagination, Smith interpreted the method of science just as French did, whose views differed from the empiricist tradition of Newtonian science. Secondly, being integrated into this framework, Aristotelian method in *Posterior Analytics* was modified by the empiricist viewpoint, resulting, not in the systematic adaptation of the mathematico-experimental method of physics to emerging social sciences, but in the synthesis of eclectic methodology in the disciplines. This was fitted well enough to the technicality of the political economy of the time to establish a system that was both empirical and logically self-consistent. As a result, these interpretations of the methodology of contemporary science paradoxically enabled him to pave the way both to deductive approach, typically formulated by Leon Warlas in the middle of the 19<sup>th</sup> century, and to the several empiricist versions of economics, from Maltus and Simon de Sismondi to historical school or institutional school, thus made his work the origin of methodological controversies in economics, as Terrence Hutchison suggested.

If compared to Reid's position in the methodology of science, Smith's philosophy of science in the paper was placed nearer to the centre of the image of the Enlightenment described repeatedly by the 20<sup>th</sup>

century critics of modernity, than other empiricists' views of the country. By regarding the 'fear' for the chaotic nature of phenomena as the psychological motive to create systematic explanations, Smith was able to grasp the core of the high-Enlightenment as such, that is, the metaphor of the rational and the simple unity of universe and the ideal of monolithic system to explain objective reality, both of which are so condemned today by the advocates of complex system and the representatives of alternative approaches in economic science, though Smith's method itself still kept strong empiricist flavour.

But beyond this, and contrary to today's common notion of Smith as 'the Newton in economics', Smith's striking originality compared to his contemporaries might be seen rather in the ending passage of the paper. As Andrew Skinner has once mentioned,<sup>61)</sup> his relativism expressed in the age of Newton, looks very modern, even to the extent that it reminds us of Thomas Kuhn, though the ideas behind it seems not to be consistent with his monistic conducts in substantial researches such as in political economy.

"And even we, while we have been endeavouring to represent all philosophical system as mere inventions of the imagination to connect together the otherwise disjointed and discordant phaenomena of nature, have insensibly been drawn in, to make use of language expressing the connecting principles of this one [Newtonian

system], as if they were the real chains which Nature makes use of to bind together her several operations.”<sup>62)</sup>

#### (4) Conclusion

Though not exactly a product of Newtonian methodology of the time, Smithian system of social sciences was a byproduct of the developments of the 18<sup>th</sup> century sciences. Newtonianism supplied rich metaphors and analogies that were used by many moral philosophers including Hume and Smith. Furthermore, Smith is one of the grand theorists of the science of Scottish Enlightenment. He was not an inventor of a ‘system’, the complete knowledge of the universe, as Descartes or Leibnitz was thought to be in 18<sup>th</sup> century Britain. Smith was one of ‘empirical scientists’ of 18<sup>th</sup> century Scottish science, who claimed to have had found the principles of sub-system, of chemical processes, or of human body, or of market economy, which were the essential parts of the entire world created by God.

This aspect of Smith’s scientific projects is, if not Newtonian, still very characteristically Scottish, in the sense that Scottish scientists in the century, starting out from Newtonian inspirations and methodological formats, bravely endeavored to carry out premature attempts to build the self-sufficient explanatory bodies of knowledge, and in so doing, stood out among their contemporaries in Britain as the

imaginative theorists of 18<sup>th</sup> century sciences, as S. Mason wrote in his *A History of Sciences*.<sup>63)</sup> In this respect, Smithian political economy developed in the context of Scottish scientific culture, especially of Newtonianism, which was, more or less, one of the bases of the great achievements in 18<sup>th</sup> century sciences.

#### Notes

- 1) Chitnis pointed out the importance of Newtonianism in the Scottish Enlightenment. See A. C. Chitnis, *The Scottish Enlightenment : A Social History* (London : Croom Helm, 1976).
- 2) See H. J. Bitterman, “Adam Smith’s Empiricism and The Laws of Nature,” 1, 2, *Adam Smith : Critical Assessments I* (London : Croom Helm, 1984). H. F. Thompson, “Adam Smith’s Philosophy of Science,” *Quarterly Journal of Economics* 79 (May 1965). J. Ralph Linger, “Adam Smith’s Theory of Inquiry,” *Journal of Political Economy* 77 No. 6 (1969). Norris S. Hetherington, “Isaac Newton’s Influence on Adam Smith’s Natural Laws in Economics,” *Journal of The History of Ideas* 44(3) (1983). Samuel Hollander, “Adam Smith and the Self-interest Axiom,” *Journal of Law and Economics* 20(1) (1977). T. D. Campbell, “Scientific Explanation and Ethical Justification in The Moral Scientists,” A. S. Skinner and Thomas Wilson (ed.), *Essays on Adam Smith* (Oxford : Oxford University Press, 1975). D. D. Raphael and A. S. Skinner, “General Introduction,” *Essays on Philosophical Subjects* (Oxford : Oxford University Press, 1980).
- 3) Philis Deane, *The State and Economic System* (Oxford : Oxford University Press, 1989) 61.
- 4) William Hamilton (ed.), *The Collected Works*

- of *Dugald Stewart* Vol. X (Bristol: Thoemmes Press, 1994) 65-6.
- 5) Adam Smith, *Lectures in Rhetoric and Belles Lettres* (Oxford: Oxford University Press, 1983) 145-6.
  - 6) See G. E. R. Lloyd, *Aristotle* (London: Cambridge University Press, 1968) Chapter 6.
  - 7) When Smith went to Glasgow University, Aristotle had already ceased to be the authority. See James Moore, "The Two Systems of Francis Hutcheson," M. A. Stewart (ed.), *Studies in the Philosophy of the Scottish Enlightenment* (Oxford: Clarendon Press, 1990). Ian Simpson Ross, *The Life of Adam Smith* (Oxford: Clarendon Press, 1995) Chapter 3.
  - 8) Thomas Reid, "A brief account of Aristotle's logic, with remarks," Henry Home, *Sketches of the History of Man* (Edinburgh, 1778) 391.
  - 9) *Ibid.*, 392-3.
  - 10) For Smith's theory of rhetoric, see Winbur Samuel Howell, *Eighteenth-century British Logic and Rhetoric* (Princeton: Princeton University Press, 1971).
  - 11) Query 31 of the second edition of *Opticks*, 1717/18.
  - 12) See, for example, Thomas Gordon, *A Manuscript of Moral Philosophy, by Mr. Thomas Gordon, Professor of Philosophy, Kings College, 1773-4, written by Alexander Thomson* (Aberdeen University Library MKS 166). James Clow, *A System of Logic to which prefixed a history of philosophy and a history of logic, by James Clow, professor of logic, Glasgow University, taken by John Campbell, 1773* (Edinburgh University Library Dc. 8.13).
  - 13) T. W. Hutchison, "Smith's Wealth of Nations," *Adam Smith: Critical Assessment* Vol. II (London: Croom Helm, 1983) 178.
  - 14) *Ibid.*, 177.
  - 15) Richard Olson, *The Emergence of the Social Sciences, 1642-1792* (New York: Twayne Publishers, 1993).
  - 16) See Christie M. Shepherd, "Newtonianism in Scottish Universities in the Seventeenth Century," R. H. Campbell, A. S. Skinner (eds.), *The Origins and Nature of the Scottish Enlightenment* (Edinburgh: John Donald Publishers Ltd., 1982). Christina M. Eagles, "David Gregory and New Newtonian Science," *The British Journal for the History of Science* Vol. 10 Part 3 No. 36 (1977). John R. R. Christie, "The Origins and Development of the Scottish Scientific Community, 1680-1760," *History of Science* Vol. 12 (1974). John R. R. Christie, "The Rise and Fall of Scottish Science," Maurice Crosland (ed.), *The Emergence of Science in Western Europe*, (London & Basingstoke: Macmillan Press, 1975). Roger L. Emerson, "Natural Philosophy and the Problem of the Scottish Enlightenment," *Studies on Voltaire and the Eighteenth Century* Vol. 242 (1986).
  - 17) Margaret C. Jacob, *The Newtonians and the English Revolution 1689-1720* (Ithaca, New York: Cornell University Press, 1976). For a critical review of her works, see John Henry, *Isis* 80: 1: 301 (1989).
  - 18) For the history of the society, see Emerson's excellent works. Roger L. Emerson, "The Philosophical Society of Edinburgh 1737-47," *The British Journal for the History of Science* Vol. 12 part 2 No. 41 (1979), "The Philosophical Society of Edinburgh 1748-68," Vol. 18 part 3 No. 47 (1981), "The Philosophical Society of Edinburgh 1768-83," Vol. 18 Part 3 No. 60 (1985), "The Scottish Enlightenment and the End of the Philosophical Society of Edinburgh," No. 21 (1988).
  - 19) Colin MacLaurin, A. M., *A Treatise of Fluxions in Two Books* (Edinburgh: 1742).
  - 20) George Berkeley, *The Analysts*, A. A. Luce & T. E. Jessop (eds.), *The Works of George Ber-*

- keley Vol. 4 (Nendeln : Nelson, 1979).
- 21) On early Newtonianism, see P. M. Heimann, "Newtonian Natural Philosophy and the Scientific Revolution," *History of Science* Vol. 11 (1973). Margaret C. Jacob, "Early Newtonianism," *History of Science* Vol. 12 (1974). Margaret C. Jacob, "New Newtonian Science and the Radical Enlightenment," *Vistas in Astronomy* Vol. 22 (1978). Robert E. Shofield, "An Evolutionary Taxonomy of Eighteenth-Century Newtonianisms," *Studies in Eighteenth-Century Culture* Vol. 7 (1978) 175-90. Eric G. Forbes, "Newton's Science and the New Newtonian Philosophy," *Vistas in Astronomy* Vol. 22 (1978). G. A. J. Rogers, "Locke, Newton and the Enlightenment," *Vistas in Astronomy* Vol. 22 (1978). Also see Jan Gorinski, "Newtonianism," *The Blackwell Companion to the Enlightenment* (Oxford : Basil Blackwell, 1991).
- 22) The Latin edition of query 31 of *Opticks* (1706).
- 23) For the role of natural science in the Scottish educational system, see Richard Olson, *Scottish Philosophy and British Physics 1750-1880* (Princeton & London : Princeton University Press, 1975).
- 24) Samuel Clarke, *A Discourse Concerning the Being and Attributed of God, The Works 1738 in Four Volumes*, Vol. I, (New York & London : Garland Publishing, 1978). Most notably, Henry Home, *Essays on the Principles of Morality and Natural Religion* (Edinburgh : A Kincaid and A. Donaldson, 1751). George Turnbull wrote to John Toland on rational theology, too. George Turnbull, British Library ADD. 4465 (The Papers of J. Toland) ff. 17-8.
- 25) Paul B. Wood, "Science and the Aberdeen Enlightenment," Peter Jones (ed.), *Philosophy and Science in the Scottish Enlightenment* (Edinburgh : John Donald Publishers, 1988). Paul B. Wood, *The Aberdeen Enlightenment* (Aberdeen : Aberdeen University Press, 1993). Shinichi Nagao, *Newtonianism and the Scottish Enlightenment : The Methaphor of Imperfect Machine* (Nagoya : Nagoya University Press, 2001). Alexander Gerard, another important Aberdonian philosopher, gave the overview of the attempt concerning educational reform. See Alexander Gerard, *The Plan of Education in the Marischal College and University of Aberdeen, with the reasons of It* (Aberdeen : James Chalmers, 1755). For institutional and social backgrounds, see Roger L. Emerson, *Professors, Patronage and Politics* (Aberdeen : Aberdeen University Press, 1992).
- 26) See A. L. Donovan, *Philosophical Chemistry in the Scottish Enlightenment* (Edinburgh : Edinburgh University Press, 1975). John P. Wright, "Metaphysics and physiology," M. A. Stewart (ed.), *Studies in the Philosophy of the Scottish Enlightenment* (Oxford : Clarendon Press, 1990).
- 27) See Shofield, (1978).
- 28) For example, Adam Ferguson was influenced by Buffon's *Natural History*, though his religious views cannot be identical with Buffon's. See Adam Ferguson, *Institute of Moral Philosophy* (Edinburgh : 1766).
- 29) Thomas Reid, *Lectures of Thomas Reid on Natural Philosophy 1757-8* (Aberdeen University Library K. 106).
- 30) Empiricist tendency was strongly seen in these representative textbooks written after John Keil's introductory works had published. Colin MacLaurin, *An Account of Sir Isaac Newton's Philosophical Discoveries* (New York and London : Johnson Reprint Corporation, 1968). Henry Pemberton, *A View of Sir Isaac Newton's Philosophy* (London : 1728).
- 31) Thomas Reid, *Ibid.*, 7-8.



- 32) In his lectures on logic taught at Aberdeen University, Reid admitted that the experimental method of natural sciences was applicable to psychology and politics, too. Thomas Reid, *The System of Logic, taught at Aberdeen 1763, by Dr. Thomas Reid, now professor of moral philosophy of Glasgow* (Edinburgh University Library DK 3.2, 1775) 90. In his *Inquiry*, he made a bold statement claiming that the method was the only legitimate way of philosophizing. Thomas Reid, *An Inquiry into the Human Mind, on the Principles of Common Sense* (Bristol: Thoemmes Antiquarian Books, 1990) 2-3. Later, facing the fierce criticism of Joseph Priestley, he became cautious to the application of Newtonian method to moral philosophy, maintaining still that this was justifiable in psychology and political philosophy. Thomas Reid, Paul Wood (ed.), *Thomas Reid on the Animate Creation* (Edinburgh: Edinburgh University Press, 1995) 183.
- 33) Reid, (Edinburgh University Library DK 3.2) 90.
- 34) For certainty and probability in British science, see Barbara J. Shapiro, *Probability and Certainty in Seventeenth-Century England* (Princeton: Princeton University Press, 1983).
- 35) Reid, (Edinburgh University Library DK 3.2) 90.
- 36) See Paul Wood's introduction to Reid's manuscripts of natural sciences. Thomas Reid, Paul Wood (ed.), *Thomas Reid on the Animate Creation* (Edinburgh: Edinburgh University Press, 1995).
- 37) Thomas Reid, Aberdeen University Library MS 2131/4/III/1-15. For Reid's study of political economy, see Kathleen Holcomb, "Thomas Reid in the Glasgow Literary Society," Andrew Hook, Richard B. Sher (eds.), *The Glasgow Enlightenment* (Phantassie, East Lothian, Scotland: Tuckwell Press, 1995).
- 38) Nagao, (2001) Chapter 6.
- 39) William Hamilton (ed.), *The Collected Works of Dugald Stewart* Vol. X (Bristol: Thoemmes Press, 1994) 8.
- 40) William Trail, *Account of the Life and Writings of Robert Simson, M. D.* (Bath: 1812) 118-120.
- 41) Antoine Arnauld, Pierre Nicole, *La logique, ou, L'art de penser*, 1662. See Moore, 1990. Smith had its Latin translation. See Hiroshi Mizuta, Adam Smith Library (Cambridge: Cambridge University Press, 1967).
- 42) For the difference between empiricist position and main stream in the methodology of economics, see Bruce J. Caldwell, *Beyond positivism: economic methodology in the twentieth century*, (London; Boston: G. Allen & Unwin, 1982).
- 43) Interpreting the first two as the assertions of 'Ockam's razor' is controversial, because the expressions of the rules are different according to the versions of *Principia*. Moreover, they appeared only from the second version of *Principia* (1713) as such. It seems that Newton became more conscious to present himself as an empiricist in the later versions. Reid's interpretation of the first ones based on the third version was rigorously empiricist. See Paul Wood's introduction of Reid, (1995).
- 44) Dugald Stewart, 68-9.
- 45) Ross, (1995) Chapter 3.
- 46) Joseph Black, *Lectures on the Elements of Chemistry, delivered in the University of Edinburgh, now published from the Manuscripts, by John Robison, LLD.* (Edinburgh: 1803) vii.
- 47) There is a good reason to be cautious about his statement on Black. His attacks on the 'speculative way' of research, seen in his scientific works, was politically motivated, too. His hatred against 'deist' tendency in natural philosophy, which was identified with rationalist

- reasoning in natural philosophy, was based upon his belief that French revolution was the result of the conspiracy of deist philosophers within Freemasonry. See John Robison, *Proofs of a conspiracy against all the religions and governments of Europe, carried on in the secret meetings of Free Masons, Illuminati, and reading societies* (Edinburgh: 1798). John Robison, *A System of Mechanical Philosophy, in Four Volumes* (Edinburgh: 1822). In fact, Black was a systematical theorist of chemistry as well as an excellent experimental scientist, who tried to integrate chemical phenomena into the frameworks of the principles of 'heat'. It is interesting that Reid seems to have praised Black only as an experimental scientist. See Paul wood, "Introduction," (1995).
- 48) Smith had Keil's textbooks on natural philosophy and astronomy. See Mizuta, (1967).
- 49) Smith, *Essays on Philosophical Subjects*, 245.
- 50) See Ross, (1995) Chapter 4.
- 51) For Condillac and Smith on political economy and methodology, see Daniel Klein, "Deductive Economic Methodology in The French Enlightenment: Condillac and Desuitt de Tracy," *History of Political Economy* 17-1 (1985). A. D. Megill, "Theory and Experience in Adam Smith," *Journal of The History of Ideas* 36(1) (1975).
- 52) Condillac did not use the word 'synthesis' because he used the term to indicate the processes of building false philosophies.
- 53) Étienne Bonnot, Abbé de Condillac, *Traité des Systèmes* (1749).
- 54) Henry Home, "On the laws of motion," *Essays and Observations* (Edinburgh: 1754).
- 55) See Donovan, (1975). Nagao, (2001) Chapter 7.
- 56) "He seems not to have considered that, in the political body, however, the wisdom of nature has fortunately made ample provision for remedying many of the bad effects of the folly and injustice of man; in the same manner as it has done in the natural body, for remedying those of his sloth and intemperance." Adam Smith, *The Wealth of Nations*, Vol. 2 (Oxford: Clarendon Press, 1976) 674.
- 57) John Thomson (ed.), *The Works of William Cullen, M. D. in Two Volumes*, Vol. I (London: 1827) 114.
- 58) *Ibid.*, 111.
- 59) David Lieberman, Knud Haakonsen (ed.), *Cambridge Companion to Adam Smith* (Cambridge: Cambridge University Press, forthcoming).
- 60) Paul B. Wood, "The natural history of man in the Scottish Enlightenment," *History of Science* 28 (1990).
- 61) Andrew S. Skinner, *A System of Social Science: Papers relating to Adam Smith* (Oxford: Clarendon Press, 1979).
- 62) Smith, *Essays on Philosophical Subjects*, 105.
- 63) S. F. Mason, *A History of Sciences* (London: Routledge & Kegan Paul, 1953), Chapter 24. (Graduate School of Economics, Nagoya University)