



HAL
open science

Adam Smith's use of multiple references for his pin making example

Jean-Louis Peaucelle

► **To cite this version:**

Jean-Louis Peaucelle. Adam Smith's use of multiple references for his pin making example. *European Journal of the History of Economic Thought*, 2006, 13 (4), pp.489 - 512. 10.1080/09672560601025829 . hal-01403682

HAL Id: hal-01403682

<https://hal.univ-reunion.fr/hal-01403682>

Submitted on 27 Nov 2016

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Adam Smith's use of multiple references for his pin making example

Jean-Louis Peaucelle

The European Journal of the History of Economic Thought, 13:4, 489-512

Abstract: At the beginning of *The Wealth of Nations* Adam Smith describes a pin factory. It is widely accepted that this example comes from Diderot's *Encyclopaedia*, published in France in the 18th century. The details in the text together with the conferences previously given in Glasgow clearly show that this one reference cannot be the only source. Three other French publications on pin making may also have been used as references for Adam Smith's text. Phrase by phrase these texts are compared to Smiths to support the assertion that he based his work on four previous French publications. *The Wealth of Nations* unites and synthesizes these different sources and excerpts those parts that confirm his theory. Smith should have listed his sources.

Key words: Adam Smith, pin-making, division of labour, sources, Encyclopaedia.

“It has been said of the first chapter of the *Wealth of Nations*, which deals with the division of labour, that it is beyond all comparison, the most popular chapter of the *Wealth of Nations*; no part of the work has been so often reprinted ... no part of it is so commonly read by children, or so well remembered by them.” This phrase comes from the beginning of Salim Rashid's 1986 article where the author cites E.G. Wakefield's commentary in the 1843 edition of *The Wealth of Nations*.

In this first chapter, Adam Smith uses the example of a pin maker to describe the division of labour. The chapter's construction, generalising from an example, is particularly striking.

This brilliant introduction however requires closer inspection. One question arises as to the origins of the example. Did Adam Smith personally observe the factory or did he develop his example from contemporary writings of his time? The questioning of Smith's sources is made difficult by the loss of his handwritten notes after his death on July 17, 1790. John Rae (1895) wrote of this deliberate destruction: “A week before his death, he expressly sent for them [Black and Hurrton] and asked them then and there burn sixteen volumes of manuscript to which he directed them. This they did without

knowing or asking what they contained. [...] When the sixteen volumes of manuscript were burnt Smith's mind seemed to be greatly relieved." What did these 16 volumes contain? Why would Adam Smith want to keep part of his work secret ?

Adam Smith used the pin maker example to advance his theory that the division of labour results in productivity improvements. The organisation of work within the small pin making industry was considered sufficiently convincing that it was used to defend an economic law. The division of labour is at the beginning of *The Wealth of Nations*.

While the study of pin making has been examined and commented at length, it still remains unclear as to where Adam Smith acquired his understanding of the pin industry. One hypothesis is that Smith himself collected the data in the field. However, we can say neither when nor where he would have done so. A second hypothesis is that his data comes from his readings. It is necessary then to identify the one original text or several texts.

We suggest that Adam Smith based his work on several French texts. In the second half of the 18th century, the Diderot's *Encyclopédie* and the Académie des Sciences de Paris explained pin manufacturing in detail. These texts were later copied, commented and synthesised. A large number of readings were thereby available to Adam Smith. Our thesis appears reasonable. It still remains to be shown however how these texts were used by Smith to construct his work.

Theories, past and present, explaining the origins of Smith's pin making example are first presented. They are then examined in light of the texts themselves. We notably highlight a number of weaknesses in the most often cited thesis, that of the use of the article « Épingles » from the *Encyclopédie*. We complete this thesis with three other documentary sources. We then show how Smith's writings are developed from these four sources.

1) Ferguson's French source

Adam Ferguson was a colleague and friend of Adam Smith. They taught the same subject, moral philosophy, in Glasgow. In 1767 he published *An essay on the history of civil society*. The division of labour was considered in the fourth chapter : "Of the separation of Arts and professions". He wrote : "a people can make no great progress in cultivating the arts of life, until they have separated, and committed to different persons, the several tasks, which require a peculiar skill and attention". Progress comes not without division of labour. Such a division enables the simultaneous improvement of

quality and productivity. “Every undertaker in manufacture finds, that the more he can subdivide the tasks of his workmen, and the more hands he can employ on separate articles, the more are his expenses diminished, and his profits increased”. “ By the separation of arts and professions, the sources of wealth are laid open” (p. 180 et 181). Profit and wealth result from the division of labour.

An Adam Smith’s thesis is exposed by his colleague before the publication of *The Wealth of Nations* in 1776. Adam Ferguson’s approach was more a sociological one however. Excessive division of labour strains social ties. “The separation of professions, while it seems to promise improvement of skill, and is actually the cause why the productions of every art become more perfect as commerce advances; yet in its termination, and ultimate effects, serves, in some measure, to break the bands of society” (p. 218). This sociological thesis, opposed to the division of labour, would later be made famous by others, notably Karl Marx.

When Adam Smith discovered his colleague’s writings, he immediately saw his own ideas. He accused Ferguson of copying. Ferguson denied any plagiarism. Both were inspired by the same source: “some unnamed French source “when Smith had been before him”” (Hamowy, 1968, p. 249 citing John Rae, 1895). Ferguson’s defence leads us towards the French origins of Smith’s ideas.

It may seem strange that Smith, who himself published in 1776, complained of plagiarism in 1767. Edwin Cannan (1896) provides an explanation. Notes taken in class by Smith’s students were published. Cannan actually found the published text that had been sold to students in Glasgow. Smith spoke in class of the division of labour as early as 1763. This same subject could easily have been discussed with colleagues.

Adam Ferguson had the opportunity to copy Adam Smith. The question is whether he did or not. Was his reference to a common French source simply a way of hiding his own plagiarism? Cannan (1896) believes so and in so doing defends the originality of Smith’s work. Others advance different hypotheses. Hamowy (1968, p. 255) argues that between 1780 and 1785 Adam Smith questioned draft texts from Adam Ferguson’s book that would later be published after Smith’s death in 1792. He notably gave the example of pin making.

In any case, the theory that French sources were used should not be discounted. What could this text have been? Many authors have debated this question.

August Oncken (1909) has no doubt that the French source was Montesquieu. « ... kann nicht wohl ein Zweifel darüber obwalten, dass er unter der älteren gemeinsamen

Quelle Montesquieu verstanden wissen wolle, niemand anders. ». Onken however, did not directly refer to the texts. He based his reasoning on Ferguson’s acquaintance with the French author. Charles de Secondat de Montesquieu (1689-1755) was known throughout Europe for his 1748 work *L’Esprit des lois (The Spirit of Laws)* . As no description of pin making appears in this text, we abandon this theory.

Contemporary experts favour the article « Épingles » (Pins) from Diderot’s *Encyclopédie* as the French source of Smith’s work.

2) The « Épingles » (Pins) article from the *Encyclopédie*

Volume V of Diderot’s *Encyclopédie*, published in 1755, included an 8 column article by Delaire entitled « Épingles » (Pins). The similarities with Adam Smith’s text indicate that this is the French source of his work.

Germain Garnier adopted this point of view in his 1802 translation into French of *The Wealth of Nations*. This translation is still that used by French economics students. The technical terms used by Delaire to describe the process are reintroduced in italics. The first stage is “a man draws out the wire”. Garnier boldly translated this phrase as « un ouvrier *tire le fil à la bobille* ». In French the word « bobille », derived from « bobine » (reel), is rarely employed. No dictionary suggests this same translation. Garnier chose to do so as he read Delaire’s text at the same time as he translated Smith’s. He extrapolated. In his text, he added an additional step from the *Encyclopédie* « piquer les papiers » (to pierce the papers). He did more than simply translate.

| | |
|---|--|
| <p>One man draws out the wire, another straightens it, a third cuts it, a fourth points it, a fifth grinds it at the top for receiving, the head; to make the head requires two or three distinct operations; to put it on is a peculiar business, to whiten the pins is another; it is even a trade by itself to put them into the paper;</p> <p>and the important business of making a pin is, in this manner, divided into about eighteen distinct operations, ...</p> | <p>Un ouvrier <i>tire le fil à la bobille</i>, un autre le <i>dresse</i>, un troisième <i>coupe la dressée</i>, un quatrième <i>empointe</i>, un cinquième est employé à <i>émoudre</i> le bout qui doit recevoir la <i>tête</i>. Cette <i>tête</i> fait elle-même l’objet de deux ou trois opérations séparées : la <i>frapper</i> est une besogne particulière ; <i>blanchir</i> les épingles en est une autre ; c’est même un métier distinct que de <i>piquer</i> les papiers et d’y <i>bouter</i> les épingles ; enfin l’important travail de faire une épingle est divisé en dix-huit opérations distinctes ou environ ...</p> |
|---|--|

Table 1. Extracts from book 1, chapter 1, *Recherches sur la nature et les causes de la richesse des nations*, Adam Smith, 1802, translated into French by Germain Garnier (italics as per the original text).

Hamowy (1968) also identified the *Encyclopédie* article as the French source of Smith’s work. His main argument is that Adam Smith and Delaire both cite 18 pin

making operations. The concordance of dates reinforces his thesis. We also know that Smith was in charge of purchases for the University of Glasgow library. He subscribed to Diderot's *Encyclopédie*. His colleagues criticised him as he used up their credits in doing so. Other works could not be purchased. Moreover, Smith reviewed the *Encyclopédie* quite favourably in the 1756 *Edinburgh Review*.

Groenewegen (1977) offers a variant. "The famous pin example, probably derived from his observations of nail making in Kirkcaldy and his reading of the article, "Épingle", in Volume V of the French *Encyclopedie*." Adam Smith was born in Kirkcaldy. He lived there until the age of 14. He returned for two years at the end of his studies. It is quite possible that he observed the town's nail making activities. A possible rebuttal is that he would have looked up the word « clou » (nail) in the *Encyclopédie* instead and in so doing he would have found a different 7 column article. It is not so simple to pass from nails to pins.

Murray Rothbard (1995, p. 443) also defends this thesis. "There is strong evidence that the "French source" for both writers was the article Epingles in the Encyclopédie".

The famous article « Épingle » (Pin) was written by Alexandre Deleyre¹ (1726-1797). A student of the Jesuits in Bordeaux, Deleyre worked as a poorly paid freelance journalist for diverse journals such as that of Diderot. He published several unremarkable works. His first on Francis Bacon was full of errors. The *Critical Review* reported "Our analyst has established absolute contradictions ... The analyst has confounded and obscured" (1757, 1th semester, page 465). Deleyre ended his career as a member of both the Convention and the Institute².

This is today's official and largely accepted version of Smith's sources. There are however several weaknesses to this theory:

- Adam Smith's first stage is that of wire drawing. "One man draws out the wire". The first stage in the *Encyclopédie* involves that "to yellow the brass wire"³. Wire drawing, « tirer à la bobille », takes place at the second stage. The texts differ on this first stage, yet they both refer to 18 stages in all.
- Adam Smith is unsure of the number of stages required to make the pin head. Is it two or three? "To make the head requires two or three distinct operations." The *Encyclopédie* clearly describes three.

¹ The right spelling of this name.

² French Academy

³ « on jaunait le fil de laiton »

- Adam Smith describes a strange fifth stage: “a fifth grinds it at the top for receiving the head.” Why grind the pin head? The rounded end would be flattened. According to the *Encyclopédie* the points are finely reworked. These activities are completely different.
- Adam Smith estimates production at 4800 pins per person, per day. The *Encyclopédie* doesn’t estimate production rates.

The *Encyclopédie* appears a difficult reference to use as it covers so many subjects. Why would Smith have thought of looking through the *Encyclopédie* for such a minor article? One rarely thumbs through a dictionary. A dictionary is typically used for a more deliberate inquiry about a precise topic. Why then was Smith so interested in pin making?

In light of this discussion, Germain Garnier’s evidence appears relatively weak. The article « Epingle » from the *Encyclopédie* was no doubt influential but it is unlikely to have been the only source. Other texts may have come between Adam Smith and the *Encyclopédie*. This is the hypothesis we defend here.

3) The multiple references hypothesis

While Adam Ferguson only spoke of one French reference that he shared with Adam Smith, the latter may have used several texts. He may only have shown one to his friend and gathered others as he worked on the subject.

The multiple references hypothesis is suggested by the following parts of his work:

- “The division of labour has been very often taken notice of, the trade of the pin-maker”. Today’s reader may be surprised by this remark. Were pins so often spoken at the time? What does “very often” mean?
- “Making a pin is divided into about eighteen distinct operations”. Why is he uncertain as to the exact number of activities involved? The *Encyclopédie* clearly spoke of 18 operations.

The multiple references hypothesis is also suggested by the differences between the texts of *The Wealth of Nations* and that of the notes taken between 1762 and 1764 by his Glasgow students (*Lectures on jurisprudence*). He already spoke in class of the division of labour and pin making. We have a written trace of Adam Smith’s thinking prior to *The Wealth of Nations*. The differences between these texts suggest that he collected new data between the two publishing dates.

In the 1763 lectures, he estimated productivity at 2000 pins per day and per person. In 1776, the level of production was 4800 pins per day and per person. This difference could be explained by the collecting of new and better information in the interim. He implies that the data were collected personally. “I have seen a small manufactory of this kind”. He may also have uncovered a new reference. This second hypothesis is now developed.

What could these references have been? The French were also interested in pins at this time. As early as 1723, Savary included an article « Espingles » (Pins) in his *Dictionnaire du Commerce (Trade Dictionary)*. He mainly detailed the organisation of the pin maker’s guild. The major texts on the pin making process were published in the *Encyclopédie*; Deleyre’s 1755 article, « Epingles », and an article by Perronet, « Epinglier » (Pin-maker), in the 1765 volume of plates.

The Académie des Sciences de Paris also wrote on the subject in 1761. Duhamel du Monceau published *L’art de l’épinglier (The art of pin-making)*, an 84 page collection of writings to which Réaumur, Perronet and Chalouzières each contributed. The texts were interwoven, with each describing a different stage of the production process. The credit given to each author showed the emerging concern for intellectual property rights. Given each contributor’s renown, Duhamel probably had no alternative but to identify the source. While Réaumur was no longer alive at the time his manuscript had been widely read. Perronet on the other hand was very much alive. In charge of the engineering school, he was an influential figure in the administration of the Ponts et Chaussées (roads and bridges).

Pin making was the subject of these three important texts, published in 1755, 1761 and 1765. A great number of minor works were also published. Many periodicals included book reviews. *L’art de l’épinglier* was reviewed several times. The volumes of the *Encyclopédie* were mentioned and its articles were reviewed from time to time. Journalists generally preferred philosophical articles. They were not really interested in pins.

Another minor text was the pin making article in technical dictionaries. The *Encyclopédie* had opened the dictionary market. As the *Encyclopédie* remained expensive, publishers filled the segment with cheaper, more specialised dictionaries. These small “portable” dictionaries were actually compilations of more voluminous works otherwise inaccessible to the general public.

All the French texts are not cited here. Many could not have been used by Smith: the publishing dates do not match, the texts differ too widely, or they were not available in Glasgow. The French texts tended to copy one another. A detailed study shows that all the publications are based on two main handwritten studies in Normandy in 1717 and 1739. This subject will be examined in a forthcoming article.

In order to explore the multiple references hypothesis all the texts were collected and examined to determine how they could explain Adam Smith's writings. Four major texts were identified. They will now be presented individually.

3.1.) *Dictionnaire portatif des arts et métiers* by Macquer

Adam Smith owned a large collection of books (Bonar, 1894). He had bought many different works during his travels in France. One purchase is particularly important here. The *Portable dictionary of arts and crafts including etc⁴*, by Philippe Macquer, published in 1766 in Paris. This dictionary contained an article entitled « Epinglier » (Pin-making).

Philippe Macquer was the brother of Pierre-Joseph Macquer (1718-1784), member of the Académie des Sciences, famous chemist, and Lavoisier's teacher. The Macquer family was of Scottish roots. The *Dictionnaire portatif* was a two volume abridged edition. It was based on *La description des Arts & Métiers (The description of Arts and crafts)*, a series edited by Duhamel in 1761. His article « Epinglier » is derived from part of this same series, *L'art de l'épinglier (Art of pin-making)*. He mainly used Perronet's text.

Macquer described in a succinct fashion the same activities as Deleyre. The first stage, as in Adam Smith's text, is to draw out the wire. «Traduction »⁵

Macquer is more precise and concise than the *Encyclopédie*. He gives work rates for eight workstations: 120 000 pins per day for the straightener (*le dresseur*), 30 000 for the putter (*la bouteuse*), and between 8 000 to 9 000 for the head maker (*l'entêteur*) (average of 8 500). The rhythms are different for each stage. We can complete those given by assuming that the grinder works at the same rate as the head maker. Adam Smith deduced an average production rate. Two calculations are possible: inverse the

⁴ *Dictionnaire portatif des arts et métiers, contenant en abrégé l'histoire, la description et la police des arts et métiers, des fabriques et des manufactures de France et des pays étrangers.*

⁵ « Les épingliers achètent le fil en bottes ; ils le passent à la filière pour lui donner la grosseur que doit avoir l'épingle ».

total of all inverted rhythms, or calculate the total of each execution rate. The second approach is the simplest.

Execution rates are the inverse of the rhythms. Assuming a 12 hour day, we have $12 \times 60 \times 60 = 43\,200$ seconds. Using Macquer’s figures, we arrive at an average execution rate of 9.06 seconds per pin. If we round this result downwards to 9 seconds, the production rate is 4800 pins per day and per person (see table 2).

| Operator | Rhythm (pins per day) | Execution rate |
|------------------------------------|--------------------------|--|
| Straightener (Dresseur) | 120 000 | 0,36 seconds |
| Point maker (Empointeur) | 72 000 | 0,6 seconds |
| Grinder (Repasseur) | 72 000 | 0,6 seconds |
| Cutter (Coupeur de hanges) | 190 000 | 0,23 seconds |
| Head cutter (Coupeur de têtes) | 144 000 | 0,3 seconds |
| Head maker (Entêteur) | 8 500 | 5,08 seconds |
| Paper piercer (Percer les papiers) | 96 000 | 0,45 seconds |
| Putter (Bouteuse) | 30 000 | 1,44 seconds |
| total | 4 800 ← | 9,06 seconds per pin rounded off to 9 seconds |

Table 2. Execution time for each pin making operation according to Macquer’s (1766) rhythms.

This calculation is straightforward. Two stages are omitted however: “to white pins in the boiler” (« blanchir les épingles dans la chaudière ») and putting them through the rub machine (« frottoire »). Macquer didn’t give the rhythms for these stages. We hence have ten stages. This may explain why Adam Smith spoke of ten workers in *The Wealth of Nations*: “I have seen a small manufactory of this kind where ten men only were employed”.

The other calculation, which involves inverting the rhythms, requires no assumption as to the length of the working day.

$$4\,768 = \frac{1}{\frac{1}{120\,000} + \frac{1}{72\,000} + \frac{1}{72\,000} + \frac{1}{190\,000} + \frac{1}{144\,000} + \frac{1}{8\,500} + \frac{1}{96\,000} + \frac{1}{30\,000}}$$

Adam Smith may have rounded up this result to obtain 4800 pins per day and per person.

In conclusion, Adam Smith is likely to have used Macquer’s text as a reference for *The Wealth of Nations*. He personally owned a copy. One can use this text to calculate the production rate of 4800 pins per day and per person. The rhythms differ par stage. Smith averaged these differences out. Adam Smith may “have seen” this “small manufactory” “where ten men only were employed” within this text.

This reference was published in 1766. It explains the difference between *The Wealth of Nations* published in 1776 and Smith's 1763 lectures. It remains to be shown why Smith referred to pin making in his 1763 Glasgow classes.

3.2.) *L'art de l'épinglier (Art of pin-making)* by Duhamel

Following on from Réamur, Duhamel du Monceau, a member of the Académie des Sciences de Paris, was in charge of publishing the scientific work about the Arts & Crafts. This work had been dragging on since the end of the previous century. The Académie was embarrassed by its non scientific nature. Diderot had access to all the Académie's documentation from the beginning of the century onwards. He notably consulted the illustrations. The success of Diderot's *Encyclopédie* changed things for the Académie. It regained interest in its publishing project. *La Description des Arts & Métiers* was first published by the Académie des Sciences in 1761. One of the first texts was *l'art de l'épinglier*. It was held by the University of Glasgow library.

Adam Smith could have read this text. We can link this work to the expression "division of labour". The concept was known to other authors although different words were used to describe it. Smith was the first to employ the expression "division of labour".

Ancient Greek authors spoke of the division of labour as did English authors at the end of the 17th century and the beginning of the 18th. We now examine the terms they employed.

Firstly, in *The Republic* (Book II), Plato explains the gains through trade specialisation.

"Adeimantus - And will you have a work better done when the workman has many occupations, or when he has only one?"

Socrates - When he has only one.

Adeimantus - Further, there can be no doubt that a work is spoilt when not done at the right time?

Socrates - No doubt.

Adeimantus - For business is not disposed to wait until the doer of the business is at leisure; but the doer must follow up what he is doing, and make the business his first object.

Socrates - He must.

Adeimantus - And if so, we must infer that all things are produced more plentifully and easily and of a better quality when one man does one thing which is natural to him and does it at the right time, and leaves other things.

Socrates - Undoubtedly.

Adeimantus - Then more than four citizens will be required; for the husbandman will not make his own plough or mattock, or other implements of agriculture, if they are to be good for anything. Neither will the builder make his tools --and he too needs many; and in like manner the weaver and shoemaker.

Socrates - True.

Adeimantus - Then carpenters, and smiths, and many other artisans, will be sharers in our little State, which is already beginning to grow?

Socrates - True.

Adeimantus - Yet even if we add neatherds, shepherds, and other herdsmen, in order that our husbandmen may have oxen to plough with, and builders as well as husbandmen may have draught cattle, and carriers and weavers fleeces and hides, --still our State will not be very large.

Socrates - That is true; yet neither will it be a very small State which contains all these.

Adeimantus - Then, again, there is the situation of the city --to find a place where nothing need be imported is well-nigh impossible.

Socrates - Impossible.

Adeimantus - Then there must be another class of citizens who will bring the required supply from another city?

Socrates - There must.

Adeimantus - But if the trader goes empty-handed, having nothing which they require who would supply his need, he will come back empty-handed.

Socrates - That is certain.

Adeimantus - And therefore what they produce at home must be not only enough for themselves, but such both in quantity and quality as to accommodate those from whom their wants are supplied." (Plato, *The Republic*, Book II, translated by Benjamin Jowett)

Xenophon goes even further. He speaks of the division of labour within the one trade, shoe making. It was an important trade for the city of Athens that imported skins and widely exported the shoes it produced.

“In the great cities, owing to the wide demand for each particular thing, a single craft will suffice for a means of livelihood, and often enough even a single department of that; there are shoe-makers who will only make sandals for men and others only for women. Or one artisan will get his living merely by stitching shoes, another by cutting them out, a third by shaping the upper leathers, and a fourth will do nothing but fit the parts together. Necessarily the man who spends all his time and trouble on the smallest task will do that task the best” (Xenophon, *Cyropaedia*, book VIII, translated by Henry Graham Dakyns, edited by F.M. Stawell, Project Gutenberg Release).

Task specialisation occurred in major industries and in large towns. It depended on the market. On the other hand, “in a small city the same man must make beds and chairs and ploughs and tables, and often build houses as well; and indeed he will be only too glad if he can find enough employers in all trades to keep him. Now it is impossible that a single man working at a dozen crafts can do them all well” (ibidem).

Adam Smith probably knew of these texts. His writings are similar : “Country workmen are almost everywhere obliged to apply themselves to all the different branches of industry that have so much affinity to one another as to be employed about the same sort of materials. A country carpenter deals in every sort of work that is made of wood: a country smith in every sort of work that is made of iron. The former is not only a carpenter, but a joiner, a cabinet-maker, and even a carver in wood, as well as a wheel-wright, a plough-wright, a cart and waggon maker.” (*The Wealth of Nations*, Book 1, chapter 3).

Through the ages task specialisation has been associated with high production volumes and quality. The term “division of labour”, however, had never been employed.

Smith’s English predecessors spoke of this same concept (Cf. Schumpeter, 1954, pp. 56, 214, 373-376, Rashid, 1998). They identified and named it in various ways. Table 3 lists some of the terms employed.

| Author | Book | Term employed to speak of the division of labour |
|-----------------------|---|--|
| Platon | <i>The Republic</i> | To have only one occupation |
| Xenophon | <i>Cyropaedia</i> | Small tasks |
| William Petty | <i>Political arithmetick, 1690</i> | A man shall make the wheels, another ... |
| Hume | <i>Political discourses, 1752</i> | By the conjunction of forces, our power is augmented; the partition of employments, our ability encreases. |
| Bernard de Mandeville | <i>The Fable of Bees, 1714</i> | Labour: the usefulness of dividing it and subdividing it |
| Thomas Mortimer | <i>A new and complete dictionary of trade and commerce, 1766, article</i> | The work, for the greater dispatch, is carried on different hands |

| | “Pin-maker” | |
|---------------|--|--|
| Adam Ferguson | <i>An essay on the history of civil society</i> , 1767 | the separation of Arts and professions separated, and committed to different persons |
| Josiah Tucker | <i>Four tracts</i> , 1774 | In the richer country, where the demands are great and constant, every manufacture that requires various processes, and is composed of different parts, is accordingly divided and subdivided into separate and distinct branches. |

Table 3. The terms employed to describe the concept of the division of labour prior to Adam Smith’s work.

Each author described the concept in his own way but all lacked a concise term. The verb “to divide” was often employed in two derived forms, “divided” and “dividing”. The substantive form was close. Adam Smith employed “division of labour”, a term that refers both to the result (work is divided and everyone has their own speciality) and to the action itself (work is divided again and again, with more and more workstations created).

Smith may have been influenced by Duhamel du Monceau who employed an equivalent expression. He wrote in the introduction to the *Art of pin-making (L’art de l’épinglier)* : traduction⁶ .

The french expression « la division de ce travail » (the division of this labour) could be interpreted as meaning “the division of the labour of pin-making” . Within the context of the sentence, this expression could also refer to the work schedule. The french word “travail” (labour, work, job, occupation) is polysemous. It can be interpreted both ways. The Duhamel’s expression « division de ce travail » may have inspired Smith’s own expression, “the division of labour”.

Duhamel’s text went on to list the 17 numbered parts. The first 16 are steps in the production process. Duhamel concludes (p.3) traduction ⁷ .

In addition, Duhamel refers to the rapidity of work. Adam Smith develops this same idea as the “productive power of labour”.

We have now identified two sources, Macquer and Duhamel du Monceau. These texts do not explain however why Adam Smith was so interested in pin making. What event triggered his interest? A periodical may have set off his interest. The hypothesis here is that it was the *Journal des sçavans*.

⁶ « Il n’y a personne qui ne soit étonné du bas prix des épingles ; mais la surprise augmentera sans doute quand on saura combien de différentes opérations, la plupart fort délicates, sont indispensablement nécessaires pour faire une bonne épingle. Nous allons parcourir en peu de mots ces opérations pour faire naître l’envie d’en connoître les détails ; cette énumération nous fournira autant d’articles qui feront **la division de ce travail** » (p. 1)

⁷ « Toutes ces opérations s’exécutent, à la vérité, avec une célérité merveilleuse »

3.3.) The *Journal des sçavans* (Scientists' Journal)

The *Journal des sçavans* was a monthly magazine, published from 1665 onwards in Paris. During the 18th century it was closely associated with the Académie des Sciences. It reported on the Académie's publications and published the minutes of the Académie's meetings. The University of Glasgow library held a subscription.

In its November 1761 edition, the *Journal* reviewed Duhamel's *L'art de l'épinglier* (pages 745-748). The text was based on Duhamel's introduction. The author listed the steps in the production process. traduction⁸. This was the first stage listed by Adam Smith in 1776.

Eighteen steps in all are given in this text: to draw (« passer à la filière »), to clean (« décaper »), to straighten (« dresser »), to cut (« rogner »), to point (« empointer »), to point again (« repasser »), to cut the sections (« couper les tronçons »), to turn the head (« tourner les têtes »), to cut the head (« couper les têtes »), to put on the head (« brocher la tête »), to punch the head (« l'assujettir »), to yellow (« jaunir ») and to whiten (« blanchir »), amount to 13 activities. The author continues with 5 more operations the iron pins (« les épingles de fer »), the black pins (« les épingles noircies »), the two heads pins (« à deux têtes »), the hairpins (« en pincettes ») and finishes with putting pins on the papers by twenty five (« l'arrangement des épingles par quarteron sur le papier »). The 18 steps of the pin making process were thereby available elsewhere than in Deleyre's text.

The *Journal des sçavans* widely cites Duhamel's work, and in particular the production rates. Traduction⁹. The text is a summary full of details, all of which would have interested Adam Smith. It is reasonable to assume that he took notice of this text.

4) Hypothesis on the way Adam Smith wrote up his texts

Having examined how each text may have contributed to Adam Smith's writings, we can now piece together their sequence of use. To begin with, Smith knew of the concept of the division of labour through his readings of classical Greek authors and past English scholars. It is likely that he regularly read scientific journals as they were published. He would have discovered the description of the production process in the *Journal des sçavans*. The example would stand out given his previous readings. He may

⁸ « La première opération consiste à passer le fil de laiton à la filière pour le calibrer »

⁹ « Toutes ces opérations s'exécutent, à la vérité, avec une célérité merveilleuse »

then have spoken about it with Adam Ferguson. Smith would have sought additional references on the matter. In Duhamel's text he would discover the term « division de ce travail ». In Diderot's *Encyclopédie* all 18 activities were clearly set out. He would have all the information he needed to prepare his Glasgow lectures. During a later trip to Paris he may have found and purchased Macquer's *Dictionnaire*. The pin making article would have been of great interest. He would now be ready to write *The Wealth of Nations*.

4.1.) Prior work on labour specialisation

Adam Smith knew his classics well. He most certainly would have read Xenophon's work on the division of labour by Athenian shoe makers. He would also have read previous British scholars. He would have known that Petty, Mandeville, Hume and Tucker all discuss the division of labour and that each uses examples to help explain the concept. Petty gave three examples of the division of labour (Hull, 1899) :

Tailoring: "cloth must be cheaper made, when one cards, another spins, another weaves, another draws, another dresses, another presses and packs; than when all the operations above-mentionned were clumsily performed by the same hand" (Petty, 1690, in Hull, 1899, T 2 p. 473),

Watchmaking: "if a man shall make the wheels, another the spring, another shall engrave the dialplate, and another make the cases, then the watch will be better and cheaper, than if the whole work be put upon by any one man" (Petty, 1693, in Hull, 1899, T 1 p. 260),

Sea transportation: "Dutch are enabled to convey goods cheaply by sea because they specialise each ship for a specific function, [...] they can afford a particular sort of vessel for each particular trade" (Petty, 1690, in Hull, 1899, T 1 p. 261).

These examples were later used by other authors. Smith's previous readings no doubt motivated him to look for other examples of work division. His childhood in the nail making town of Kirkcaldy may have influenced his choice of a metallurgical activity. After all, his family name does signify "metal worker".

4.2.) Interpretation and use of the *Journal des sçavans*

The multiple references hypothesis starts with these preliminary activities. Adam Smith regularly read periodicals and the *Journal des sçavans* was one such publication that would have regularly published articles of interest. In 1761 he could have discovered the review of Duhamel's *L'art de l'épinglier* (*Art of pin-making*). The numerous steps in pin making would have interested him. The description was original. Neither Petty nor Xenophon had used this example.

Adam Smith would have spoken to Adam Ferguson about this text. His colleague would perfectly understand the economical implications. He would even draw a number of sociological conclusions. The text itself begins this same analysis. Traduction ¹⁰. The local lawyer Chalouzières, consulted by Duhamel, gave a sympathetic eye witness account of factory workers toil. It would be the catalyst for Adam Ferguson's sociological analysis.

Adam Smith also recognised the negative social consequences of the division of labour. "The man whose whole life is spent in performing a few simple operations ... has no occasion to exert his understanding ... He ... generally becomes as stupid and ignorant as it is possible for a human creature to become ... His dexterity at his own particular trade seems, in this manner, to be acquired at the expense of his intellectual, social, and martial virtues". (*The Wealth of Nations*, Book V, chapter I, part 3 article II).

On the division of labour's more technical aspects, Smith erroneously described the point sharpening on double headed pins. The French journal described this step rather ambiguously. The traduction ¹¹, could be understood as meaning that the pin was sharpened at both ends. Yet the text referred specifically to the « tronçons », or sections, of two pins. The labourer worked on longer pieces of metal that he could more easily hold between his fingers. He then cut the section into two separate pins.

Adam Smith ignored the difference between the sections and the pins. He wrote "a fifth grinds it at the top for receiving the head". He never mentioned the cutting of the section into two pins (the *Encyclopédie*'s 7th activity). Maquer's text was just as confusing and no doubt comforted Smith in his interpretation.

¹⁰ « On fait aussi quelques remarques générales sur le métier d'épinglier ... Ce métier est très-mal-propre & contraire à la santé. La rouille du laiton, qui est verd-de-gris, agit sur les ouvriers plus ou moins selon la place qu'ils occupent dans la fabrique ... Les empointeurs ne sont pas robustes, meurent pulmoniques & de bonne heure »

¹¹ « les empointeurs forment les pointes sur les meules d'acier ... Des repasseurs ou finisseurs les adoucissent sur une autre meule plus fine. Lorsque les fils des tronçons sont ainsi appointis par les deux bouts, il faut les couper à la longueur des épingles ». « Appointis par les deux bouts »

After reading this first text he then read either the *Encyclopédie* or Duhamel du Monceau. The order is of no particular importance.

4.3.) Interpretation and use of the article « épingle (Pins) in the *Encyclopédie*

Once he had become interested in pin making Adam Smith consulted Diderot's *Encyclopédie*. He found Delaire's article, « Epingle ». The second paragraph spoke of 18 stages. Traduction ¹². The rest of the text was numbered 1 through 18. This would have no doubt reassured Smith that there were 18 stages in all.

At the end of the text he read: 18° put on the pins traduction¹³ (No other production rate is given. Adam Smith probably believed this to be the production rate he was looking for, “the productive power of labour”. If 36 000 pins “must” be papered each day, then the workshop has to produce 36 000. With 18 people working, one at each workstation, Adam Smith calculated the productivity rate at 2000 pins per day and per person.

4.4.) Interpretation and use of *L'art de l'épinglier* by Duhamel

Adam Smith acquired the text reviewed in the *Journal des sçavans*. He read it before, after or at the same time as the *Encyclopédie*. He read through Duhamel's Art of pin-making . He began by the introduction. During his readings he picked up the expression « division de ce travail » (division of this labour), so close to that used by Mandeville (“the dividing of labour”). He noted the number of stages now to be 17.

He saw the illustrations. The plates showed the tools, the machines, the labourers at work. The Académie des Sciences' illustrators, as those of the *Encyclopédie*, grouped the workers in one relatively large and tidy room. The labourers appeared to work in one workshop. Smith adopted this same view.

Smith used these three texts to document his *Lectures on Jurisprudence*. He would complete his documentation with the purchase of Macquer's *Dictionnaire* in France.

4.5.) Reading of the *Dictionnaire portatif des arts et métiers* by Macquer

In this new text, Adam Smith found understandable production rates. Macquer grouped together and simplified Perronet's figures that had previously been published by Duhamel. There are 8 distinct work rates. Smith would have been looking for a

¹² « Une épingle éprouve dix-huit opérations avant d'entrer dans le commerce »

¹³ « On boute les épingles . C'est les placer dans le papier. On les prend à poignée, on les range par douzaine à la fois : il le faut bien, pour bouter jusqu'à 36 milliers d'épingles par jour ; encore ne gagne-t-on, quand on y excelle, que trois sous. »

global production rate. He would have worked with the figures and found a production rate of 4800 pins per day and per person.

Adam Smith presented these results in a strange way. He took the weight into account. “They could, when they exerted themselves, make among them about twelve pounds of pins in a day. There are in a pound upwards of four thousand pins of a middling size? Those ten persons, therefore, could make among them upwards of forty-eight thousand pins in a day. Each person, therefore, making a tenth part of forty-eight thousand pins in a day.” The production was weighed daily: 12 pounds of 4000 pins.

Smith’s use of weight in his measure of production is difficult to understand. There were pins of different sizes. While the number of pins was not affected by size, the total weight of the pins was. Production time does not vary with pin size whereas it does with weight. According to Perronet there were 13000 number V pins per pound, 4000 number X pins, and only 1350 of the biggest size, number XXII. According to pin size, weight may vary tenfold, while work time varied little. Smith’s idea of a pin “of a middling size” is imprecise. The most sold pins were the smaller sizes, number IV or V.

Why did Smith measure production rates based on weight when production time depended on the number of pins and not on their weight? One possible hypothesis is that he may have done so to hide his use of the French texts. This is difficult to verify. In any case he gave a production rate equivalent to that of the French texts, 4800 pins per day and per person.

4.6.) Summary of Adam Smith’s references

Adam Smith had access to four French texts, the *Journal des sçavans*, the *Encyclopédie*, Duhamel, and Macquer. These texts are coherent with the evolution of the different versions of his writings. We can match his ideas with those developed in these texts. Tables 5 and 6 compare Smith’s descriptions of pin making with the French references we presented previously.

| <i>Lectures on Jurisprudence</i> , Monday, March 28, 1763 (pp. 341-342) | Original text | Reference |
|--|---|--|
| “The division of labour amongst different hands can alone account for this” | « cette énumération nous fournira autant d’articles qui feront la division de ce travail » | <i>L’art de l’épinglier</i> de Duhamel, 1761 |
| “an instance frivolous indeed, but which will illustrate it; this is the pin-making” | Description of pin making | <i>Journal des sçavans</i> , 1761 |
| “one cutts the wire” | « 4° On coupe la dressée », | <i>Encyclopédie</i> , Delaire, 1755 |
| “another sharps the one end for receiving the head” | « les fils des tronçons sont ainsi appointis par les deux bouts » | <i>Journal des sçavans</i> , 1761 |
| “another sharps the one end for receiving the head” | « Il faut former des pointes aux deux bouts de ces tronçons de fil » | <i>L’art de l’épinglier</i> de Duhamel, 1761 |
| “3 or 4 are employed in making the head” | « 8°. On tourne les têtes. 9°. On coupe les têtes. 10°. On amollit les têtes. » | <i>Encyclopédie</i> , Delaire, 1755 |
| “one puts it one, another forms the point, another gilds and another papers them.” | « 11° on frappe les têtes, 5° on empoite 13° on blanchit les épingles, 18° on boute les épingles. » | <i>Encyclopédie</i> , Delaire, 1755 |
| “So that in the making of a pin there are about 18 persons employed. These in a day will make about 36000 pins, and this comes to the same thing as if each one made about 2000.” | « une épingle éprouve dix-huit opérations» « il le faut bien pour piquer 36 000 épingles par jour » | <i>Encyclopédie</i> , Delaire, 1755 |
| <i>Lectures on Jurisprudence</i> , Report dated 1766 (p. 490) | | |
| “the pin maker therefore divides the labour among a great number of different persons, the cutting, pointing, heading, and gilding are separate professions.” | « 4° On coupe la dressée, 5° on empoite, 11° on frappe les têtes » | <i>Encyclopédie</i> , Delaire, 1755 |
| “Two or three are employed in making the head” | « 8°. On tourne les têtes. 9°. On coupe les têtes. 10°. On amollit les têtes. » | <i>Encyclopédie</i> , Delaire, 1755 |
| “one or two in putting it on, and so on, to the putting them in the paper” | « 11° on frappe les têtes, 18° on boute les épingles. » | <i>Encyclopédie</i> , Delaire, 1755 |
| “...being in all eighteen. By the division every one can with great ease make 2000 a day.” | « une épingle éprouve dix-huit opérations » « il le faut bien pour piquer 36 000 épingles par jour » | <i>Encyclopédie</i> , Delaire, 1755 |
| <i>Lectures on Jurisprudence</i> , Report dated 1766 (p. 539) | | |
| “This must be much more the case when a person’s whole attention is bestowed on the 17 th part of a pin” | 17 parts of the text | <i>L’art de l’épinglier</i> de Duhamel, 1761 |
| <i>Lectures on Jurisprudence</i> , Early draft (p. 566) | | |
| “One man straightens the wire, another cut it, a third points it, a fourth grinds it at the top for receiving the head, there or four people are employed about making the head, to put it on is the business of a particular person, to gild the pins is the occupation of another, it is even a trade by itself to put them in the paper.” | « 3° On dresse le fil, 4° on coupe la dressée, 5° on empoite, 6° on repasse, 8°, 9°, 10°, 11° on frappe les têtes, 13° on blanchit les épingles, 18° on boute les épingles. » | <i>Encyclopédie</i> , Delaire, 1755 |
| “When this small operation is in this manner divided among about eighteen persons, these eighteen will perhaps among them make upwards of thirty six thousand pin a day.” | « une épingle éprouve dix-huit opérations» « il le faut bien pour piquer 36 000 épingles par jour » | <i>Encyclopédie</i> , Delaire, 1755 |

Table 5. Similarities between Smith’s previous texts (prior to *The Wealth of Nations*) and the French references

| <i>Inquiry into the nature and causes of the Wealth of Nations</i> , Livre I, chapitre I, 1776 | Original text | Reference |
|--|---|--|
| “The effects of the division of labour, in the general business of society” | « Cette énumération nous fournira autant d’articles qui feront la division de ce travail » | <i>L’art de l’épinglier</i> de Duhamel, 1761 |
| “and those employed in every different branch of the work can often be collected into the same workhouse, and placed at once under the view of the spectator.” | The 7 illustrations show workers labouring in the same room. | <i>L’art de l’épinglier</i> de Duhamel, 1761 |
| “To take an example, therefore, from a very trifling manufacture; but one in which the division of labour has been very often taken notice of, the trade of the pin-maker;” | Multiple references exist | |
| “One man draws out the wire” | « la première opération consiste à passer le fil de laiton à la filière » | <i>Journal des sçavans</i> , 1761 |
| “another straightens it, a third cuts it, a fourth points it, a fifth grinds it at the top for receiving the head; to make the head requires two or three distinct operations; to put it on, is a peculiar business, to whiten the pins is another; it is even a trade by itself to put them into the paper;” | « 3° On dresse le fil, 4° on coupe la dressée, 5° on empoigne, 6° on repasse, 8°, 9°, 10°, 11° on frappe les têtes, 13° on blanchit les épingles, 18° on boute les épingles. » | <i>Encyclopédie</i> , Delaire, 1755 |
| “and the important business of making a pin is, in this manner, divided into eighteen distinct operations” | « une épingle éprouve dix-huit opérations » | <i>Encyclopédie</i> , Delaire, 1755 |
| “I have seen a small manufactory of this kind where ten men only were employed, and where some of them consequently performed two or three distinct operations.” | « Ils le passent à la filière [...] on dresse le fil [...] on la coupe en tronçons [...] l’empointeur leur fait une pointe à chaque bout [...] le repasseur [...] le coupeur de hanches [...] le coupeur de têtes [...] l’entêteur, on blanchit, la bouteuse » soit dix opérations | <i>Dictionnaire portatif des arts et métiers</i> , Macquer, 1766 |
| “They could, when they exerted themselves, make among them about twelve pounds of pins in a day. There are in a pound upwards of four thousand pins of a middling size. Those ten persons, therefore, could make among them upwards of forty-eight thousand pins in a day. Each person, therefore, making a tenth part of forty-eight thousand pins, might be considered as making four thousand eight hundred pins in a day.” | Production rate calculated at 4 800 pins per day and per person. | <i>Dictionnaire portatif des arts et métiers</i> , Macquer, 1766 |

Table 6. Similarities between *The Wealth of Nations* and the French references

The multiple references hypothesis is a feasible one. The references were accessible to Smith, the dates match and the ideas are similar. Does this suffice? Any further proof was lost with the destruction of Smith's personal notes.

If we accept the hypothesis that Smith found inspiration in the four French texts, one question still remains unanswered. The texts are very rich. They provide a great deal of detail that was not exploited. For example, in Duhamel's text, Perronet identified only 14 steps in the production process. This figure was never cited by Smith. Other details are also omitted. Why? There are two possible answers. Firstly, these details are not required to illustrate the phenomenon under study. Secondly, the complicated vocabulary used made these details difficult to understand.

Adam Smith sought to demonstrate that the division of labour improved production rates. He used the French texts only to describe the extent of the division of labour, expressed as the number of steps (17 or 18 depending on the reference), and the daily production rate per person (2000 or 4800 depending on the reference). He narrowed his reading of these texts as only these details counted.

Another reason that may have led him to narrow his reading was the deliberately esoteric technical vocabulary employed. Diderot chose this writing style and Duhamel copied him. The *Journal des sçavans* and Macquer, on the other hand were more readable. It's quite possible that Smith only read parts of these texts and skimmed over the more complicated sections. This assertion however cannot be proven.

5) The implications of the multiple references hypothesis

The comparison of the French and the English texts tend to confirm our hypothesis. It is highly likely that Adam Smith used the *Journal des sçavans*, the *Encyclopédie*, Duhamel and Macquer to write up his pin making example to illustrate the division of labour.

This hypothesis is consistent with the way Adam Smith worked: wide general knowledge, interest in variety of disciplines, open to opportunities provided by current affairs, in-depth use of documentation, talent for interpreting and reworking available information. He worked hard on the pin making example. It was no doubt of great importance to him. He used at the beginning of his book and in such a way that it could not be ignored.

One could criticise him, as we would an author today, for not citing his sources. Yet he behaved like many intellectuals of his time, often forgetting to cite his references.

Was there any plagiarism? Given the extent of his personal contribution, it would seem not. The question is pertinent however as “he was peculiarly excitable about the idea of plagiarism” (Hamowy 1968, p. 253).

Adam Smith’s skill lay the way he used his different sources to construct an illustrative example of his thesis on the quantitative impact of the division of labour. He suggested the term “division of labour”, a well devised term in light of previous scholarly work. The expression communicates both an idea of movement and that of ongoing specialisation. This dual meaning rendered the term a versatile one, and in so doing made it easier for others to work with the concept.

Adam Smith didn’t use “productivity” to describe the second key concept of his theory. He called it “the productive power of labour”. He could quite easily have used the more modern term “productivity”. According to the *Dictionnaire historique de la langue française* the latter term was invented in France in 1766.

The multiple references hypothesis does not help explain one important part of Smith’s pin making thesis. The production rate of 1 to 20 pins per day of a polyvalent worker is not given in the French texts. This reference still remains a mystery.

6) Bibliography

- Bonar J., 1894, *A catalogue of the library of Adam Smith*, rééditions en 1932 et 1966.
- Cannan E., 1896, *Introduction to Smith’s Lectures on Justice, Police, Revenue and Arms*, Oxford.
- Ferguson A., 1767, *An essay on the history of civil society*, Edinburgh, réédité en 1966.
- Ferguson A., 1792, *Principles of Moral and Political Science*, Edinburgh.
- Groenewegen P.D., 1977, “Adam Smith and the division of labour: a bicentenary estimate”, *Australian Economic Papers*, December, 161-174.
- Hamowy R., 1968, “Adam Smith, Adam Ferguson, and the division of labour”, *Economica*, Vol. XXXV, 249-259.
- Hull C.H., 1899, *The economic writing of Sir William Petty*, London, Cambridge University Press.
- Kettler D., 1965, *The social and political thought of Adam Ferguson*, Ohio State University Press.

- Macquer Ph., 1766, *Dictionnaire portatif des arts et métiers, contenant l'abrégé en abrégé l'histoire, la description et la police des arts et métiers, des fabriques et des manufactures de France et des pays étrangers*, Paris, Lacombe, 2 volumes.
- Mortimer T., 1766, *A new and complete dictionary of trade and commerce*, London.
- Oncken A., 1909, Adam Smith und Adam Ferguson, *Zeitschrift für Socialwissenschaft*, vol. XII Part I, 129-137, Part II, 202-216.
- Petty W., 1690, *Political arithmetick*, London.
- Petty W., 1893, *Another essay in political arithmetic*, London.
- Rae J., 1895, *Life of Adam Smith*, réédité en 1965 avec une introduction de Jacob Viner, Sentry Press, N.Y..
- Rashid S., 1986, "Adam Smith and the division of Labour: a historical view", *Scottish Journal of Political Economy*, Vol. 33 (3), 292-297.
- Rashid S., 1998, *The myth of Adam Smith*, Edward Elgar, N-Y.
- Ross I.S., 1995, *The Life of Adam Smith*, Clarendon Press, Oxford.
- Rothbard M.N., 1995, *Economic thought before Adam Smith, an Austrian perspective on the history of economic thought*, Edward Elgar Publishing, England, 1995
- Schumpeter J.A., 1954, *History of economic analysis*, N-Y.
- Smith A., 1776, *Inquiry into the nature and causes of the Wealth of Nations*, London.
- Smith A., 1978, *Lectures on jurisprudence*, edited by Meek, Raphael, Stern, Clarendon Press.