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TECHNICAL DETERMINISM: THE STIRRUP AND THE PLOUGH

TECHNICAL DETERMINISM IN HISTORICAL STUDIES HAS OFTEN BEEN combined with adventurous speculations particularly attractive to those who like to have complex developments explained by simple causes. The technical determinism of Professor Lynn White, Jr.,* however, is peculiar in that, instead of building new and provocative theories about general historical development on the basis of technical studies, he gives a misleadingly adventurist cast to old-fashioned platitudes by supporting them with a chain of obscure and dubious deductions from scanty evidence about the progress of technology. This is particularly marked in the first two of the three chapters of his book, *Medieval Technology and Social Change.*

R.H.H.
P.H.S.

I

In the first chapter Mr. White argues that the key to the evolution of European feudal society is the stirrup. He claims that this valuable device only reached the Franks early in the eighth century and that it immediately led to a revolution in their fighting methods.

The stirrup, by giving lateral support in addition to the front and back support offered by pommel and cantle, effectively welded horse and rider into a single fighting unit capable of a violence without precedent. The fighter's hand no longer delivered the blow: it merely guided it... Immediately, without preparatory steps, it made possible mounted shock combat, a revolutionary new way of doing battle (p. 2).

He argues that this possibility was quickly exploited by the Franks and there was therefore a "drastic shift from infantry to the new mode of mounted shock combat" in the eighth century (p. 27). This military development had important social and economic consequences and the stirrup is held to account for the "almost explosive development" of feudalism towards the middle of the eighth century. Mr. White goes on to claim that "the original and basic knight's service was mounted shock combat" (p. 31). As "the duty of knight's service is the key to feudal institutions" (p. 31) the significance of the stirrup, which made mounted shock combat

possible, in Mr. White’s understanding of European History would be hard to exaggerate. He is, therefore, able to conclude:

Few inventions have been so simple as the stirrup, but few have had so catalytic an influence on history. The requirements of the new mode of warfare which it made possible found expression in a new form of western European society dominated by an aristocracy of warriors endowed with land so that they might fight in a new and highly specialized way. Inevitably this nobility developed cultural forms and patterns of thought and emotion in harmony with its style of mounted shock combat and its social posture . . . Antiquity imagined the Centaur; the early Middle Ages made him the master of Europe (p. 38).

The most serious weakness in this argument is that the introduction of the stirrup is not in itself an adequate explanation for any changes that may have occurred. The stirrup made new methods possible, not inevitable. Mr. White apparently accepts this for he writes:

The historical record is replete with inventions which have remained dormant in a society until at last — usually for reasons which remain mysterious — they ‘awaken’ and become active elements in the shaping of a culture to which they are not entirely novel . . . As our understanding of the history of technology increases it becomes clear that a new device merely opens a door; it does not compel one to enter. The acceptance or rejection of an invention, or the extent to which its implications are realized if it is accepted, depends quite as much upon the condition of a society, and upon the imagination of its leaders, as upon the nature of the technological item itself (p. 28).

It is remarkable that Mr. White has failed to see that this admission undermines his main thesis. He has still further weakened his argument by accepting the view that the English continued to fight on foot long after they knew of the stirrup. The Battle of Hastings was, we are assured, “a conflict between the military methods of the seventh century and those of the eleventh century” (p. 37). If the stirrup made so little difference in England, why were its consequences so dramatic on the other side of the Channel? Had Mr. White been prepared to accept the view that the English and Norman methods of fighting were not so very different in the eleventh century, he would have made the weakness of his argument less obvious, but the fundamental failure would remain: the stirrup cannot alone explain the changes that it made possible.

Nevertheless, if it could be shown that the stirrup’s possibilities were fully exploited by the Franks almost as soon as they knew the device we could profitably begin to consider why Frankish society was ready for the change while other societies, including possibly the English, were not. Mr. White claims that the stirrup was “in fact a new arrival when he [i.e. Charles Martel] used it as the technological basis of his military reforms” (p. 28). This claim is so important that it demands careful examination.

Mr. White argues that the foot stirrup was known in China by the
fifth century and that it slowly spread westward to reach the Franks early in the eighth century. An essential part of this neat chronological scheme is that the steppe nomads were unfamiliar with stirrups before the seventh century. The weakness of the arguments used to support this assertion is well illustrated by the following passage:

Our opinion about the dating of the use of stirrups by the nomadic horsemen may be influenced by the fact that Iran, with all of its Central Asian connections, was not familiar with the stirrup until the end of the seventh century. This lack is the more curious because in the third and fourth centuries the Sassanids conquered and ruled considerable areas of the present Afghanistan and Pakistan which presumably then had some sort of hook-stirrup (p. 17).

If the Persians did not adopt the hook stirrup from the east, their failure to adopt the foot stirrup from the north hardly proves that their northern neighbours lacked stirrups. More astonishing is the admission in a footnote (p. 16), added as the book went to press, that miniature stirrups have been found in Siberia "which can scarcely be later than the third century A.D. and may belong to the first century A.D.". This makes one regret that "the efforts of Rostovtzeff and Arendt to endow the ancient Sarmatians or Scythians with stirrups" have been dismissed by Mr. White as "groundless" with so little argument (p. 16).

It is claimed that "archaeology . . . is decisive" for this dating (p. 27). There are, however, two principal difficulties. First, the Franks had been converted to Christianity early in the sixth century and their graves thereafter are less valuable for the archaeologist, who has to rely on the graves of those Germans, such as the Alemanni, who were converted in the eighth century. What is true of these people may not be true of the Franks to the west. There are in fact some stirrups from Germanic cemeteries but Mr. White is at pains to demonstrate that these are all from the eve of the conversion. The argument is not always very convincing, as for example, "The Pfahlheim cemetery is richer . . . of seven horse burials, only one — doubtless the latest — includes stirrups" (p. 24). This must rank as one of the most remarkable chronological determinations in European archaeology. Mr. White does not attempt to conceal the difficulty of archaeological dating, but he has perhaps used the difficulties in a rather one-sided way; they are emphasized particularly in connection with finds that do not fit his scheme. It is, however, as misleading to insist that all finds of stirrups must be late as it is to insist that they must all be early. In most cases the margin of chronological uncertainty is large and should remain so. We can
therefore hardly be certain that the stirrup only reached the Franks in the eighth century. What is quite certain is that had the stirrup been used by Franks in the seventh century there would be little archaeological evidence of it for the Franks were then Christian.

Manuscript illuminations are not very helpful either. These first show stirrups in use in the ninth century, but as Mr. White insists, “iconography lagged behind actuality” (p. 25). There is no means of telling how long this time lag was. In any case there are far more manuscript illuminations of the ninth century, after the Carolingian renaissance, than of the seventh and eighth centuries, and this may well be the explanation for the lack of earlier depictions. The uncertainty of the archaeological and pictorial record is not resolved by other kinds of evidence, despite Mr. White’s claim (p. 27) that we can show by other means that the stirrup must have reached the Franks in the early eighth century. The first of these “other means” is linguistic. Mr. White asserts: “at that moment the verbs insilire and desilire, formerly used for getting on and off horses, began to be replaced by scandere equos and descendere, showing that leaping was replaced by stepping when one mounted or dismounted” (p. 27). The authority for this is Schlieben who refers to three texts in support, two of the ninth century and one of the tenth. These can hardly justify the use of the phrase “at that moment” to mean the middle of the eighth century. Another argument for this eighth-century introduction of the stirrup into western Europe is the “complete change in Frankish weapons which took place at that time” (p. 27). The infantry weapons are said to disappear in the eighth century and the spatha lengthens into a longsword for horsemen. One need go no further than Mr. White’s note on page 146 for an indication that these longswords are found as early as the sixth century. The last argument is that the Carolingians developed a special new type of lance with a cross piece, a design intelligible only “in terms of the new style of mounted shock combat with the lance at rest” for the cross piece is designed to prevent too deep penetration. In the Bayeux Tapestry many of the lances or spears used by both English and Normans have such a cross piece and Sir James Mann’s comment on this point is worth repeating: “This is another indication of the fairly early date of the Tapestry and derives from the spear with the large cross-bar of Anglo-Saxon times. The cross piece is of no help to a horseman as it might easily injure the forehand of his horse, and for that reason one sees here that cross-pieces are more common, sometimes amounting to two or three, on the spears in the hands of footmen than they are on the lances of the horsemen.” (The Bayeux Tapestry, ed. Sir Frank Stenton, London, 1957, p. 67).
The evidence therefore shows that stirrups were used by Germanic peoples by the eighth century but it does not allow us to date their introduction into western Europe more precisely. They may well have been used long before Charles Martel ruled the Franks.

The most remarkable weakness in Mr. White's argument is his insistence that mounted shock combat became the rule from the eighth century. There is no evidence to support this claim and there is much against it. Most strikingly the Bayeux Tapestry shows most of the Normans throwing spears, only two or three have their lances under arm and the artist has emphasized the point by showing the throwing spears as very thin and the couched lances as thicker. Mr. White's attempt to explain this evidence away is unconvincing. He writes: "the representation of the lance held at rest made its way very slowly: it lacked the magnificence of gesture of the blow struck with the arm and this latter is found even in the Bayeux Tapestry, from an age when it can seldom have been seen in combat" (p. 147). Some warriors had certainly developed the technique of shock combat but there is no evidence that this was general before the twelfth century. The stirrup made it possible to fight on horseback more efficiently in other ways than with a couched lance. It generally helped the stability of the rider and enabled him to use a sword with less danger of falling off, and it gave the mounted warrior the advantage of a fast moving, elevated platform from which to throw things.

Mr. White emphasizes the expense of mounted warfare. The point is important if familiar. He has, however, failed to see that horses made fighting expensive however they were used. His obsession with shock combat has obscured this important point. Whether or not the English fought on horseback, the core of the English army consisted of thegns who rode to battle and regarded the possession of one or two horses as essential. If the wealth of the medieval knight is economically and socially significant, so too is the wealth of the English thegn.

Mr. White has attempted to support his drastically oversimplified thesis by an overwhelmingly elaborate apparatus. The thirty-eight pages of this chapter are furnished with eighteen pages of notes in an appendix as well as the footnotes. The relevance of many of these notes is only marginal but they do provide a rich collection of references which may be useful for the further study of the subject. Unfortunately the references given to support the main argument often fail to bear the weight put upon them. A student of medieval poetry is credited (p. 30) with an opinion that was really held by
a medieval poet. We are assured that the Bayeux Tapestry shows that most of the Anglo-Saxons were equipped with round or oval shields as opposed to the kite-shaped shields of the Normans and the English king’s bodyguard. This is not so, unless oval shields are kite-shaped. We are told that “by about the year 1000 miles had ceased to mean soldier and had become knight”, (p. 30) but the references do not really seem to say this. Mr. White too often sees what he wishes to see in his authorities and as many of his references are difficult to check, fundamental flaws may easily be overlooked. There is indeed a danger that the impressive array of references may lead some to give greater credence to his arguments and assertions than they deserve. Even as a bibliography of feudalism the notes are inadequate, for Mr. White has so concentrated on the military aspect that he has failed to consider the complexities being revealed by modern students in the very society he seeks to explain.

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II

It is nowadays a common assumption that there must have been an improvement in the productivity of agriculture to make possible the population growth, the urbanization and the commercial expansion of eleventh- to thirteenth-century Europe. This growth must have had an economic basis. Government, art, building, new social institutions, warfare, luxury imports and manufactures had to be paid for, and were paid for in cash. Given the agrarian basis of society, the obvious conclusion is that these elements of the social and political superstructure were derived from the surplus product of agriculture, surplus, that is, after the subsistence of the basic producers had been provided. Whether this increased available surplus resulted from an increase of agricultural productivity per head or whether it resulted from greater efficiency in diverting the surplus from the producers to the non-producers (for example in higher rents and taxes) has not been decided. Professor Georges Duby in his recent fine survey of medieval agrarian history (L'Economie rurale et la vie des campagnes dans l'Occident médiéval, Paris, 1962) argues for the first alternative and in this partly agrees with Mr. White. But his chronology differs substantially from Mr. White’s and his handling of evidence conforms to scholarly standards.
Mr. White's argument in his second chapter is that the generalization of the use of what he calls the heavy plough in the Frankish heartland in the seventh century resulted in the development of the three field system, or rather of triennial rotation, and of open field, communal agriculture. The increased production of spring crops made oats available for feeding horses which replaced the less efficient oxen in the plough team, thus increasing production. The introduction of legumes as a "vast and integral part in the new triennial rotation" (p. 75) from the late eighth century brought about an addition to the protein content of the people's diet. All this was at the back of the economic growth and the "new exuberance of spirit which enlivened that age" (p. 76).

The localization of this agricultural revolution to the Frankish lands under the Carolingians fits in with the accepted chronology of some French and German cultural and political historians. But the evidence does not satisfy, and an important corollary, that open field agriculture was unknown in England before the Danes, seems not only unproved but perverse.

According to Mr. White's scheme, the basis of Carolingian technical advance was the generalization of the use of iron. Borrowing a commonplace of prehistoric archaeology, that iron is first found in cultural contexts dominated by bronze, he even hints that the true Iron Age only begins with the Carolingians. But what proof is offered that "great new iron mines" were opened up in Carolingian times (pp. 40 and 153)? There is no quantitative evidence cited from archeological research. Instead we have impressive looking footnotes to E. Salin's *La Civilisation Mérovingienne* (Paris, 1949-59) and to the authors cited by Salin. These turn out to be references by certain Arab chroniclers to remarks about the export of swords by Franks and *Rus* to the Middle East. They have no chronological or quantitative precision. There is also another literary reference — to the alarm expressed by the King of the Lombards at the weight of metal possessed by the Franks at the siege of Pavia, 773. Mr. White admits that this remark is only symbolic. But in fact the possibility is that the iron came not from Francia but from Scandinavia.

Is the "heavy" plough any better documented in association chronologically and topographically with the Carolingians? Two of the best authorities which Mr. White himself quotes (F. G. Payne, "The Plough in Ancient Britain", *Archaeological Journal*, civ, 1947; and A. G. Haudricourt and M. Delamarre, *L'homme et la charrue à travers le monde*, Paris, 1955) should have warned him that the simple contrast of *aratrum* and *carruca* — in his terms, "scratch" and
“heavy” ploughs — is most unhistorical. So is the derivation and counterposing of their supposedly associated agrarian systems, the individualist enclosed and the communal open systems. However, relying on conclusions by another scholar based on Slavonic linguistics, he assumes that the heavy plough could not have been known to Slavs or to Germans before the sixth century. Passing thence to suggestions by German historians about a seventh-century population expansion in central and south western Germany, he makes the unjustified assumption that (if this were indeed true) it must have been caused by the adoption of the heavy plough.

If the heavy plough and the open field system originated in the Frankish lands and were the basis of Carolingian expansion, they cannot be allowed elsewhere. Therefore Mr. White ignores the following statement by F. G. Payne: “[the Belgic plough] even by modern standards ... cut a strong furrow. The plough turned the furrow slice to the right or ‘furrow side’ only, and in consequence those who used it ploughed in ‘lands’ or ridges” (op. cit. p. 97). This puts the heavy plough in the first century B.C. But having ignored Payne’s argument, Mr. White tries to dispose of the Laws of Ine (late seventh century). He relies on F. Seebohm’s English Village Community (1890 edition) and H. L. Gray’s English Field Systems (Harvard, 1915) for comment on the appropriate law. He apparently does not know Anglo-Saxon England by England’s leading contemporary Anglo-Saxon scholar, Sir Frank Stenton. Sir Frank, in common with most other authorities, considers that cap. 42 of Ine’s Laws proves the existence in the seventh century of open field communal agriculture. Mr. White, basing himself not on his own critique of the Laws, but on an article in a local German geographical magazine, suggests that as the Laws are only known in an Alfredian recension, they are “presumably updated in some respects” (p. 51). Mr. White says that the law only mentions “strips and common pasture”, but anyone who has read the law will realize that it refers clearly to mixed ownership parcels in arable and meadow, and refers to the practice frequently found in later manorial court records of joint responsibility by the villagers for fencing the crops to keep the animals out until the harvest. Mr. White’s view that this cannot mean open fields and a communally controlled agrarian system is untenable. His assumption that the communal aspect of open field agriculture depends on the practice of co-oration is, of course, mistaken, as any medieval village by-law will demonstrate.

If open field agriculture was unknown in early England, how did it get there? From Francia via the Danes, says Mr. White. He
asserts, but does not prove, that the OE sulh was a scratch plough with a small team. In fact, the Kentish term sulung, derived from it, meant a unit of ploughing subdivided into four yokes each of two oxen. But Mr. White argues that the main proof of the Danish importation of heavy plough and open field system is in the new terminology of land tenure in the Danelaw, whereby the English hide gave way to the Danish ploughland or carucate, subdivided into eight oxgangs. This is taken as sufficient evidence for the introduction of the heavy plough and of the practice of co-aration. For the latter practice, however, he has to resort to the Welsh laws of Howell Dda. This argument from a change in land tenure nomenclature is also made a little ludicrous by the author's reference to the "bovates and virgates of the Danelaw" (p. 53). As most students know, the virgate, or yardland, was a sub-division of the hide not of the ploughland. Had he read his Stenton he would have had to explain away the following sentence: "At this date [seventh century] the yard of land undoubtedly had its primitive meaning of a tenement formed by detaching one rood — a strip of arable one rod or geard in width — from every acre in a hide. The use of this term is in itself proof of the existence of open fields in seventh-century Wessex" (op. cit., p. 309).

None of the evidence produced by Mr. White to support his theory of the Danish origin of the heavy plough in England is adequate. And since he believes, again without giving supporting evidence, that the introduction of this plough and the consequent conversion of the field system meant that "all previous rights of ownership in specific blocks or strips must be abolished" (p. 54), it might be thought odd that such a dramatic subversion of property rights should nowhere be reflected in the written evidence. We must therefore accept the present interpretation of the law of Ine. Since this means that the open field communal agrarian system was in existence in seventh-century England, the chronology of the so-called agricultural revolution in the Carolingian Empire is in jeopardy.

Can we at least accept that the three course crop rotation had its origin in the Carolingian Empire? To do so in Mr. White's terms would mean retaining an old fashioned interpretation of the two and three field systems. But recent work suggests that the sharp distinction between the two systems is unreal. The basis of medieval rotation systems was rather the cultura or furlong than the field. The reduction of the amount fallowed from one half to one third of the ploughed area was not necessarily the consequence of the introduction of spring crops. As Mr. White knows, pretending it was only
exceptional (p. 74, n. 1), many villages could have only half of the arable under crop while growing on that half a high proportion of spring crops. These crops — barley and oats primarily — were known in the north in prehistoric times, as archeological evidence has shown. By the time we have the evidence of the ninth-century Carolingian polyptyques we are hardly justified in saying, with Mr. White, that these crops formed a massive proportion of the total sowing. There is indirect evidence that there might have been a third of the arable sown with spring crops on some of the most highly organized estates, but on the whole it would seem that winter sown bread grains predominated. Where there was a large scale sowing of oats, this was hardly a technical innovation designed to provide fodder for horses but normally where soil and climate did not permit the sowing of a better crop. As far as crop yields are concerned — a rather crucial test of a revolutionary improvement in agriculture — the Carolingian evidence is minute, but what there is shows very poor yields.

What of Mr. White's suggestion that this period saw a large-scale transformation of diet by the introduction of legumes? No evidence is given, but what can be deduced from later evidence suggests that during the period of population expansion the medieval agriculturalists' response to growing demands for food was to increase the bread grains. There may well have been an increase in the proportion of spring grains sown, barley, drage or oats according to local soil and climate. In addition to being used for bread and pottage, these grains were of primary importance as sources of malt for ale. In England, at any rate, the really important period for a big increase in the sowing of peas and beans seems to have been the fourteenth century.

Mr. White's account of the social and economic developments of post-Carolingian Europe could well involve a reversal of cause and effect. Did the increased availability of food cause an increase in population? What may have happened was that an increasing population provided for its subsistence by an extension of the cultivated area as much as by an increase in productivity. The reduction of the area under fallow was not so much a choice made by the cultivator as an inescapable necessity in view of the increased pressure of population. Thirteenth-century evidence of declining yields on old settled lands suggests that the reduction in the fallow may have been self-defeating. The extension of the arable at the expense of meadow and pasture increased the area under cereal crops but by reducing the amount of feed for beasts deprived medieval agriculture
of manure and traction power. By the second half of the thirteenth century most peasant holdings were understocked and demesne flocks did not reproduce as they should have done because of the pasture shortage. In view of these facts, Mr. White's transports about the replacement of the ox by the horse are irrelevant. Indeed in Bedfordshire it seems that the horse known as the affer or stott was primarily the poor man's draught beast, the lords preferring the ox (*The Taxation of 1297*, Bedfordshire Historical Record Society, xxxix, ed. A. T. Gaydon, p. xxviii).

In brief, it cannot be said that Mr. White has established the eighth century as the crucial period of agricultural advance underlying the expansion of early medieval civilization. His article in *Speculum* in 1940 seemed to promise a work extending and proving the theories of Lefebvre des Noëttes and others, but the promise has not been fulfilled. Whatever may ultimately emerge from basic research on this period, no satisfactory thesis can be built on as fragile an evidential basis as we find in this book. At first glance the bibliographical foundation of the work seems most impressive, but when crucial steps in the argument are traced back to the evidence cited, the impression of solid backing is dissipated. We now get the impression that the author's theories are produced in a speculative vacuum and that with the aid of a card index of European periodicals, both well known and obscure, an apparatus to support the theories is built up. Mr. White relies on secondary works entirely. This is quite in order in a work of synthesis. But there is no critical examination of the secondary authorities, even where (as in the case of the Laws of Ine) the primary sources are easily available as a check. It is, in fact, difficult to avoid the conclusion that secondary sources which fail to support the author's *a priori* reasoning are conveniently ignored.

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