The Enclosure of Open Fields: Preface to a Study of Its Impact on the Efficiency of English Agriculture in the Eighteenth Century

IN 1700 much of the land of England was farmed under the ancient system of open fields. With its three great fields planted in a communally regulated rotation of crops, its common meadows and wastes, and its mixture of holdings in hundreds of strips less than acre each, this apparently inefficient system had characterized the agriculture of northern and eastern Europe for centuries.[1] In England it had never been universal and had from an early date been subject to erosion at the edges, giving way by agreement among tenants and by compulsion from landlords to compact enclosure. Yet in 1700 a broad swath of England from the North Sea across the Midlands to the Channel exhibited the system in a more or less complete form. A century and a half later, 5,000-odd acts of Parliament and at least an equal number of voluntary agreements had swept it away, transforming numerous and vague rights of use to open fields, commons, and waste into unambiguous rights of ownership to enclosed plots, free of village direction. The enclosure movement, particularly its climax in the sixty years of intense parliamentary activity after 1760, has long been among the dozen or so central concerns of British economic and social historians, a concern warranted by the importance of the event: through the statistical haze one can discern that something on the order of

[1] One of the chief tasks of scholarship on the open fields has been to document the variety and flexibility of the system. Nothing in the argument that follows, however, depends on the oversimple characterization used here.

half the agricultural land of England was enclosed during the eighteenth and nineteenth centuries.[2]

It is on the social effects of this transformation that historians have fixed their gaze. The emphasis has been put on equity, not efficiency: as the Hammonds put it, "We are not concerned to corroborate or to question the contention that enclosure made England more productive. . . . Our business is with the changes that the enclosures caused in the social structure of England."[3] The fixation on the issue of equity is curious, for the enclosures altered the conditions of production in a large sector of the economy: the event is ideal material for an inquiry into the sources of economic growth. The source of growth here is not, of course, capital accumulation or technological change of the usual sort, but a mere rearrangement of legal rights to land. If the word "precondition", as it is used in the literature of economic growth includes anything it must include the formation of the legal institutions of private property, of which enclosures are a case in point. And economists and economic historians, in their separate ways, have not been notably successful in explaining growth with alternative categories, such as investment in machinery or the introduction of great inventions, suggesting that its legal preconditions would repay close study.

I

The less efficient were the open fields, clearly, the more would their enclosure increase the efficiency of English agriculture. One might suppose, therefore, that it would be possible to answer directly the question of how enclosure affected efficiency by analyzing the economics of the open fields. There is a fundamental obstacle to this program, but the analysis does suggest an alternative and less direct one which has more likelihood of success.

[2] The estimate excludes Wales. An estimate of English agricultural land of roughly 24 million acres can be inferred from the contemporary estimates (including arable, meadow, pasture, and woods) quoted in Lord Ernle (R. E. Prothero), *English Farming Past and Present*, 6th ed., a reprint of the 5th edition with additional introductions by G. E. Fussell and O. R. McGregor (Chicago: Quadrangle Books, 1961), p. 503. The area enclosed by parliamentary act, 6 million acres, is the estimate of F. Clifford, *A History of Private Bill Legislation*, I (London, 1885), 495. The area enclosed by private agreement, 8 million acres, is an estimate or, more candidly, a guess by Gilbert Slater in a review of the Hammonds' *The Village Labourer* in *The Sociological Review*, V (Jan., 1912), 63 ff.

[3] J. L. and Barbara Hammond, *The Village Labourer*, reprint of the 4th ed. (1927) (London: British Publishers Guild, 1948), I, p. 19.

Historical opinion has for the most part accepted the judgment of contemporaries, sixteenth-century opponents of enclosure as well as eighteenth-century enthusiasts, that the open field system was wretchedly inefficient. The scattering of each man's holdings in dozens of small strips had direct costs in waste of time moving from one strip to another and in the disincentive to enterprise created by the spill-over of one man's sloth or malice onto his neighbors' strips. Furthermore, scattered strips implied common grazing on the fallow, with consequent over-use of the land and the spread of animal disease. In turn, common grazing implied the subjugation of each man to communal decisions on when grazing should give way to crops and what crops should be planted, regardless of his land's comparative advantage. So plain has the inefficiency seemed that the question has been not why enclosure occured when it did, but why it did not occur earlier.

It is hazardous, however, to attribute inefficiency to a social arrangement as persistent as the open fields, for the following reason. The allocation of resources in open field agriculture would have been efficient if it had yielded the highest value of output attainable with the inputs available to the village. The open fields are supposed not to have achieved this result. But when conscious village intervention or unconscious social custom have defined property rights in crops, labor, capital, and use of land, and have assigned these rights to someone, to do what he wishes with them, including selling them, the rights can move by self-interested exchange into the hands of those who value them most. When all such mutually advantageous exchanges have taken place, the allocation of property rights to various tasks is by definition efficient: resources have been put to their highest-valued use. In other words, to the extent that property rights were well-defined and exchangeable (as in many cases they were from an early date) and to the extent that peasants pursued their self-interest (as there is little doubt they did), the economy of the village would arrive at an efficient allocation of resources without formal enclosure.[4]

This argument considerably complicates the task of explaining the persistence of the open fields and casts doubt even on the pre-

[4] Readers of R. H. Coase's important article, "The Problem of Social Cost," *Journal of Law and Economics*, III (1960), 1-44, will recognize this as an application of his argument.

sumption that they were inefficient. Of course, the costs of exchanging property rights were not always low. The argument serves only to direct attention to these costs, as a necessary condition for the survival of inefficiencies, and to the possibility that the system was more efficient than has been supposed. In other words, it disciplines thinking on the reasons for the persistence of the system, pushing deeper the discussion of its rationale.

The argument applies to all features of the open fields, but with special force to their central feature, the scattering of strips. In the usual explanations, one or another *deus ex machina*—common plowing, partible inheritance, the clearing of waste, egalitarian instincts —is lowered into the action to scatter the strips, but when it has been lifted back into the rafters of the stage the question arises why its effects persist. The egalitarian explanation will serve to illustrate the nature of the difficulty. Its long historiographic career began with Paul Vinogradoff: "The only adequate explanation of the open-field intermixture . . . [is that] it has its roots in the wish to equalize the holdings [of men allotted land] as to the quantity and quality of land assigned to them in spite of all differences in the shape, the position, and the value of the soil."[5] Maitland, with many later historians, concurred: "Who laid out these fields? The obvious answer is that they were laid out by men who would sacrifice economy and efficiency at the shrine of equality."[6]

In common with the other traditional explanations of scattering, such as common plowing, partible inheritance, or the joint clearing of waste, however, the egalitarian explanation has the difficulty that intermixture is an inefficient way of establishing equality, just as it is an inefficient way of avoiding the inconvenience of early or late plowing of one's land, of distributing land among numerous heirs, or of allotting parcels after clearing new fields in the waste lands. A community bent on establishing equality—although the argument is flawed at the outset in view of the great inequalities in the size of holdings in the typical open field village—may well choose to simplify its task of equalizing the value of holdings by

   [5] P. Vinogradoff, *Villainage in England* (Oxford, 1892), p. 254.
   [6] F. W. Maitland, *Domesday Book and Beyond* (Cambridge, 1897), p. 337. Compare Ernle, *English Farming Past and Present*, p. 25; E. Lipson, *The Economic History of England*, I (London: Black, 1915), p. 65 ff; and George C. Homans, *English Villagers of the Thirteenth Century* (Cambridge, Mass.: Harvard University Press, 1941), p. 91.

merely distributing a bundle of strips from all parts of the village to each family, rather than by adjusting the sizes of consolidated holdings to their quality.[7] Once this random distribution of strips had assured a rough equality among holdings with respect to their qualities of location, drainage, and fertility, however, each member of the village would benefit from exchanges of strips to achieve consolidation. Equality would not be disturbed, for the exchanges would have to be mutually beneficial for the villagers to engage in them, but efficiency would be increased. In other words, even if egalitarian sentiment influenced the initial distribution of property rights in land, it does not follow that it influenced their subsequent allocation. A market in land—the prior development of a money economy is not necessary, although it would have reduced the costs of reallocating land—with different prices for different qualities would have permitted the attainment of consolidated and efficient holdings, if not immediately, then surely by the sixteenth or seventeenth centuries. One must either deny that exchanges of land were possible, in the face of evidence that they in fact occurred from an early date, or abandon the egalitarian theory of the persistence, if not the origin, of scattered holdings.

The one explanation of scattering (and with it many of the other features of the open fields) that withstands this simple criticism is that strips were scattered to reduce risk. It withstands it because villagers did not have cheap access to markets in risk, that is, insurance, as they did in land, labor, and output. One might suppose, therefore, that they were driven to hold land in scattered strips to hedge against disasters befalling only one type of soil (such as excessive rainfall on low-lying clays) and to diversify their crops, holding land in each of the open fields of the village, to hedge against disasters raising the price of only one part of their food.

This is nothing more than an attractive supposition now, attractive because it has many testable implications. It gives some promise that the analysis of the open field system might be put on a surer footing, in which case it could be used to infer directly what gains in efficiency were to be had from an enclosure. The criticism of the

   [7] Vinogradoff, *Villainage in England*, p. 235 ff, argues that this administrative convenience was important. He briefly recognizes the difficulty that subsequent exchanges would transform the system, but dismisses it by appeal to the continuing strength of "the communal principle with its equalizing tendency."

traditional explanations suggests that the direct measurement of inefficiency will be difficult: inefficiencies are always prey to market erosion, even while maintaining their outward form; and if the hypothesis of risk aversion proves to be correct they may not in fact have existed. It does, however, suggest an alternative approach.

II

The alternative reverses the direction of the preceeding argument. The open fields persisted for many centuries; the enclosure of the Midlands, on the other hand, was accomplished in sixty years. To explain the persistence of the open fields it is natural to emphasize the power of markets to erode inefficient arrangements: each separate use of the market, as for example an exchange of strips, reduces the inefficiencies, and the summation over centuries of these steps, however small, can be expected to eliminate them entirely. To explain as comparatively brief an episode as the enclosure movement, however, it is natural, in contrast, to emphasize the limits on the market's power to erode inefficiencies, limits imposed by the costs of transacting in markets: there is no passage of centuries in this case to reduce transactions costs to insignificance, only sixty years of intense effort in leaping over them. The open fields, at one time desirable but by the eighteenth century not, could be propped up for many years if the market exchanges entailed in their dissolution were expensive. Exchanges of land were not free, as the great expenses incurred in parliamentary acts for circumventing voluntary exchange of lands in enclosure testifies. The costs of changing from one system of agriculture to another must figure prominently in an account of the enclosure movement.

The costs of change need to be considered for more than mere descriptive completeness, however, for their existence makes it possible to measure the increase in efficiency as a village moves from open fields to enclosures. If there had been in fact no costs of change one could not observe a jump in efficiency on enclosure: enclosure would occur at the instant it became to any small degree more efficient than open fields, leaving no trace in increased output, rents, or employment. But there were costs of change, and therefore there was at the time of each enclosure some increase in efficiency to be observed. Assuming that it is profitable, each enclosure project must recover in increased output at least the coat incurred in under-

taking it. The costs recovered can be divided into two parts: those that represent the withdrawal of resources from alternative employment elsewhere in the economy (such as fencing costs); and those that do not, being mere transfers of income from one group to another (such as bribes to opponents of enclosure in the village and the bulk of parliamentary fees). On the one hand the output of the economy is increased through higher agricultural output by an amount equal to at least the sum of both costs; on the other hand it is decreased by the costs that represent the withdrawal of resources from elsewhere. The minimum net increase in national output at the time of an enclosure, then, is the total cost (equal to or smaller than the gain in agricultural output) minus the opportunity cost of the resources withdrawn; that is to say, it is the portion of costs that represent income transfers alone.

The increase in national output at the time of each enclosure, however, in only a lower bound on the true increase attributable to enclosures at some terminal date. It is plainly not possible to know directly what national output would have been had enclosures not occured. Events did not perform the relevant experiments. No one set aside in 1760 a group of typical villages to be exempted from enclosure and to act as a control in an experiment to determine its ultimate effects; nor did anyone in 1820 put the enclosed fields back for a time into an open state to satisfy the curiosity of later historians. Assessing the "impact" of enclosure necessarily involves the experiment of removing its influence from the scene at some date and observing the fall in national income that results. The actual costs and benefits at the time of each enclosure are not directly relevant because they are not results of the relevant experiment.

The relevant mental experiments can be performed only if one knows what determined the variations in the costs and benefits of enclosure from one village to another and from one time to another. The experiments can be narrow or broad, depending on whether one wishes to be cautious or bold in making historical inferences. A cautious program, for example, would be to ask what the effect was on English national output of some small modification of the costs of enclosure, such as the passage of the General Enclosure Act in 1801 or the variation in fencing costs from region to region. To answer these questions one must isolate the effects of the

fall in legal costs or the variation in fencing costs on the rate of en-
closure and the net output resulting from it. The isolation can be
achieved by explaining statistically the observed variations in costs
across time and across regions, and then relating the costs to the
rate of enclosure and the rate of enclosure to the increase in output
resulting from it. In a similar fashion, on the benefit side one might
ask and answer the questions what effects changes in the price of
wheat or regional variations in the quality of soil had on enclosure,
and through enclosure on national output. The bold program would
be to ask what the effect would have been of prohibiting enclosure
altogether. This broader question is implied by asking what im-
pact enclosure had on national output. To answer it, as to answer
the more narrow questions, one has to know what the costs and
benefits of enclosure were under the actual circumstances by com-
parison with what they would have been under alternative circum-
stances. That is to say, one has to construct and to fit to the observed
facts a model of the rate of enclosure, a model that specifies the in-
fluence of fencing costs, the price of wheat, changes in the law, and
so forth on its costs and benefits. Although the fitting of the model is
not accomplished here, its construction is, and to that task we now
turn.

III

The costs of enclosing an open field were tightly bound to the
state of development of the law. If one reflects that enclosure was
a mere reassignment of property rights in land, it becomes plain
that there is no technological reason that an enclosure should have
been costly: if imposed by some external authority with no regard
for equity, it could have been achieved overnight by the simple
expedient of assigning all legal rights to land to one person in the
village, chosen in any way the authority fancied. A conquerer can
achieve by the threat of his sword and a stroke of his pen a result
of eliminating inefficiencies of an earlier social arrangement on
which a society of laws must spend many years and much expense.
Legal constraints on enclosure preserved equity at the cost of mak-
ing it more expensive than it need have been. The agreements
fashioned under these constraints varied in complexity and solemnity
from temporary exchanges of land among a few peasants to full
parliamentary enclosure, and each had its own special array of

costs, increased gratuitously by the notoriously clotted state of the
law of land and contract before the reforms of the nineteenth
century. In consequence, even as parliamentary procedures cheap-
ened and became prevalent, the older procedures continued to be
used in many enclosures.

Under the common law one procedure was enclosure by piece-
meal exchanges of land, each landowner slowly building up a
more and more consolidated holding until enclosure was accom-
plished. An alternative was to agree to one simultaneous exchange
of land. Simultaneous exchange had the advantage over piecemeal
exchange that it achieved more rapidly whatever gains were to be
had from enclosure, but the disadvantage that it required one
large agreement rather than many small ones: a landowner enter-
ing such an agreement was taking the risk that his new and unfami-
liar holding would be substantially worse than his old one, a risk
he did not face if he built up a new holding gradually, testing each
piece of land as he bought it.

The common law put up many obstacles to either method of
enclosure. For the larger freeholders, the ingenuity of common law
lawyers in protecting a family's estate from the depredations of
profligate heirs had by the eighteenth century reversed earlier tenden-
cies towards the freer alienation of land. For the copyholders, the
ambiguity of their title to the land had long prevented them from
engaging in frequent exchanges, the more so as they shared with
the freeholders, large and small, the burdensome expenses imposed
on transactions in land by the common law and its lawyers.

Some enclosures would not be worthwhile if they could not be
achieved rapidly, and under the common law a rapid simultaneous
agreement to enclose was difficult to achieve. All those who owned
rights in the open field, however small, had to be brought into an
agreement for it to be legally binding, for the common law quite
reasonably required that a man's consent be obtained before the
community could meddle with his property. What was perhaps
less reasonable was that at the same time another part of it made it
impossible for some parties to the agreement—minors, for instance,
or those with life interests in entailed estates—to give their con-
sent. In the seventeenth and early eighteenth centuries men eager
to enclose sometimes called on the other law of England, equity, to
help them out of this difficulty. The route to enclosure by way of

the law of equity, however, was in most counties only infrequently travelled and was eventually abandoned, superceded in the middle of the eighteenth century by parliamentary procedures even more completely than were the common law procedures of voluntary agreement.

The parliamentary procedures—that is, statute law—had two related advantages over those available under either equity or the common law. They had, first, the advantage of special solemnity and permanence, and the constitutional power to override much of the other law. This was necessary in order to prevent one man from imposing on his fellow villagers a revival of the open fields whenever it suited his immediate convenience, by reasserting his ancient rights of common after the enclosure. Without the force of a parliamentary statute to restrain him, each villager had often the power to dissolve the agreement. The second advantage of parliamentary procedures is that they eliminated another power vested in each villager under the common law, namely, the power to veto the enclosure by virtue of the requirement that the consent of every owner of common rights be obtained. Parliament required only that owners of land agree, and only a majority of them (in the middle of the eighteenth century usually four-fifths). The amount a man could extract from the sponsors of an enclosure, once limited only by the entire social gain, was now limited by the substitutability of others' votes for his in achieving a majority. The bribes required for an agreement and the negotiating costs of fashioning it when all the many parties involved had the power to block it were sharply reduced at a stroke.

The effect of the fall in costs would vary with the character of the village, in particular with its size. The rule of unanimity of the common law is crippling to a project of enclosing a large village because it is more likely to contain at least one recalcitrant than a small village. The introduction of a rule of majority sharply reduces the importance of the difference in size, at least as it relates to the likelihood of failure in a vote on an enclosure. Indeed, if the likelihood of recalcitrance is low, whether from altruism or from fear of reprisals, the likelihood of failure is higher for a small village than for a large one.[8]

[8] The reasoning here is somewhat naive, leaving to one side as it does the question of how the shift from unanimity to majority will affect the strategic behavior

The likelihood of failure in a vote was only one of the obstacles to enclosure whose importance varied with the size of the villages. Their effective size was reduced in parliamentary procedures by the limitation of the franchise to freeholders, but it remained true, as it had been before, that large villages were on balance more costly to enclose. The costs of locating and buying out or coercing recalcitrants were higher, as were the costs of surveying the holdings and arbitrating the welter of claims involved in an enclosure. The special significance here of the size of villages is that it is easy to measure, at least by comparison with some of the other characteristics of villages that affected the cost of enclosure, and is therefore a good candidate for inclusion in a statistical analysis of its variation.

A number of other determinants of cost varied from one place to another. The cost of physically altering the face of the village, particularly fencing costs, had measurable variation, as did the extent of old enclosure, an important factor in the complexity of the undertaking. The specialists in the services required in an enclosure, such as lawyers, surveyors, and commissioners, were no doubt mobile over wide areas, but to the extent that they were not, their costs could vary as well. All these factors—village size, fencing costs, and the rest—can be brought to bear on a statistical analysis of regional variations in the costs, and therefore the rate, of enclosure.

The costs of enclosure, then, varied across regions, and varied in different ways for voluntary and for parliamentary enclosures. They also varied across time, providing another dimension in which to view the effect of differing circumstances on the cost and rate of enclosure. To treat first the variables common to both voluntary and parliamentary enclosure, it is clear that the costs of fencing, surveying, and so forth varied with time. Further, any enclosure involves present costs in expectation of future returns. The rate of interest, which is the price of future income in terms of present income, is therefore relevant to an explanation of variations in the

of the villagers in casting their votes, but it is nonetheless suggestive. It depends on a binomial model of the probability of ayes and nays. If the fraction of recalcitrants is as low as 15 percent among the population of voters, under the rule of unanimity villages of ten voters will on average vote to enclose 27 percent of the time they are presented with the choice, but villages of twenty voters only 7 percent of the time. On the other hand, under the rule of a four-fifths majority the ten-voter villages will achieve enclosure 82 percent of the time, and the twenty-voter villages 93 percent of the time.

rate of enclosure. T. S. Ashton put great emphasis on the rate of interest in this connection, observing that for the late eighteenth century there is a good correlation between the yield on consols and the rate of enclosure.[9] Later discussions, however, have generally raised Ashton's point only to reject it, for two reasons.

The first is that landlords sponsoring an enclosure did not always have to borrow money or, what is equivalent, to sell assets to finance them. The possibility of financing an enclosure out of current income, however, is irrelevant to the issue of the importance of the interest rate. If the sponsors chose to spend current income on an enclosure rather than to borrow they would not, it is true, face future outlays of cash for interest payments; but they would face, although not in the form of a piece of paper with a demand for cash written on it, the stream of future income foregone by choosing not to invest in alternative projects with yields which could be expected to run parallel with the yield on consols. Self-financing, in other words, has an opportunity cost, and this cost is related to the current rate of interest.

The second reason for denying the rate interest a central place in a discussion of the rate of enclosure also rests on a misapprehension of what is germane to the decision to invest. The objection is that the correlation between the yield on consols and the rate of enclosure breaks down during the Napoleonic Wars, a great many enclosures being undertaken then despite a high interest rate. Ashton pointed out that the sharp rise in the relative price of agricultural products could well have offset the rise in interest rates by increasing the benefits of enclosure relative to its costs. A more direct response is available, however, namely, that it is not money rate of interest which measures the real opportunity cost of an investment, but the rate of interest corrected for the expected rate of inflation in the general level of prices. A commitment to pay £5 per year in the future for the right to use £100 now is a very satisfactory arrangement for a borrower if the rate of inflation is 5 percent per year, for the real rate of interest is in this case zero: since his £100 of borrowed capital will be worth £105 next year from the

[9] T. S. Ashton, *An Economic History of England: The Eighteenth Century* (London: Methuen, 1955), p. 41 ff, gives his argument. Chambers and Mingay are among those who disagree with Ashton. See J. D. Chambers and G. E. Mingay, *The Agricultural Revolution 1750-1880* (London: Batsford, 1966), p. 82 ff.

effect of inflation alone, he can meet the interest payment by selling off £5 of it and can keep for himself whatever real fruits the capital bears as a clear gain. From their experience in the 1790's Englishmen had very likely come to expect a rate of inflation by 1800 of 2 or 3 percent per year, and in fact these expectations were confirmed by the experience of the next decade. Under these circumstances the money rate of interest of around 5 percent corresponded by 1800 to a real rate of interest of around 2 or 3 percent, which compares favorably with the rates prevailing during the earlier burst of enclosures in the late 1760's and 1770's. In short, the interest rate does on the face of it contribute to the explanation of the rate of enclosure.

Any enclosure, whether achieved by agreement under the common law or by act of Parliament, entailed costs of fencing, surveying, and interest foregone. For common law enclosures little is known—or, given the paucity of records, directly knowable— about how the other costs of enclosure, such as legal fees, organizational effort, and transfer payments to recalcitrants, varied from year to year. The only clue is based on their substitutability for parliamentary enclosures; one would expect the total cost of common law enclosures to move in step with that of parliamentary enclosures, because the availability and threat of one procedure would limit the costs of the other.

The legal and customary requirements of disclosure to public view of each step in parliamentary procedures, in contrast, generated voluminous records of their cost. The records suggest that the parliamentary procedures were progressively simplified and cheapened. The expenses of commissioners, in whose hands the details of the enclosure were placed, were a substantial part of the total cost, and it is therefore significant that the number of them specified in each act fell during the second half of the eighteenth century from a dozen or so to three or four. A general act of 1773 (13 Geo. III. c. 81) reduced and standardized the majority required to set in motion the parliamentary procedures from four-fifths to three-fourths of the number and value of the acreage in a village, voted by its owners. The individual acts came to specify the date by which an award of new holdings was to be promulgated, to meet the frequent complaint that commissioners, taking on the responsibility for too many enclosures at once, dallied at their work on each

and prolonged the interval of uncertainty between the act and the award. The commissioners gradually became a professional class and could be expected to have become more proficient as their experience broadened: the name of any given commissioner recurs many times in different acts. The experience of Parliament itself, particularly in the first period of substantial parliamentary enclosure in the late 1760's, no doubt had a similar cumulative impact on the ease with which a petition was made a law. True, not until 1836 (6 & 7 Wm. IV. c. 115), well after the period of massive enclosure, was a truly general act for enclosure passed, under which the special appeal for exemption of each enclosure from the law of property was eliminated. The passage of the so-called General Enclosure Act of 1801 (41 Geo. III. c. 109) was a victory for the improving spirits on the Board of Agriculture such as Arthur Young, but only a partial one: the requirement that each enclosure receive the specific approval of Parliament was retained. Among other simplifications, however, the framers of bills for enclosure could now draw on forty standard clauses, much to the distress of the legal profession, and affidavits were now accepted in lieu of the physical presence of the signatories to a petition. Each of these improvements in the procedures provides a test of the sensitivity of the rate of enclosure to changes in its costs and can be inserted together with the other influences on costs into a statistical analysis of their progressive reduction.

It will seem odd to argue in this fashion that the costs of parliamentary enclosure were reduced in view of the plain evidence in the literature on enclosure that the costs rose dramatically after the middle of the 1780's. In Warwickshire, whose experience was not unusual, for example, J. M. Martin found that the public costs—that is, the costs of securing the act, paying the commissioners and surveyors, and fencing the allotments of the owners of tithes—rose sixfold from the earliest to the latest enclosures, especially after 1790.[10] An adequate allowance for the general inflation of the Napoleonic Wars would reduce the sharpness and extent of the rise somewhat, but it would still be substantial.

As useful as this evidence is for providing a quantitative variable to be explained in a statistical examination of the determinants

[10] J. M. Martin, "The Cost of Parliamentary Enclosure in Warwickshire," *University of Birmingham Historical Journal*, IX (1964), reprinted in E. L. Jones (ed.), *Agriculture and Economic Growth in England 1650-1815* (London: Methuen, 1967).

of costs, is does not reveal directly how the costs of a given enclosure moved. As Martin and others have pointed out, the recorded costs rose not because an enclosure of given complexity had become more expensive, but because progressively more complex enclosures were undertaken as they became more profitable. There is direct evidence of this increasing complexity in the widening interval between the date of the act and of the actual award: in W. E. Tate's list of parliamentary enclosures in Nottinghamshire, for example, the interval is around two years in the 1760's and 1770's, but rises to six years by the 1790's and 1800's.[11] Each year's delay increased the real costs of enclosure by reducing the incentive to conserve one's soil, which on the morrow might become someone else's.[12] What is to the point here, however, is that a long interval is indicative of a complex and therefore costly enclosure, an enclosure, for instance, of a large village with many owners of land or other rights and with many parcels severely scattered and intermingled. A typical enclosure in 1810 was different from one in 1770. The observed increase in costs is a reflection of the increased benefits, not increased costs, for an enclosure of given specifications.

IV

The discussion so far has considered only the size of the costs of enclosure. There remains the size of the benefits. Many students of the enclosure movement have emphasized not the size of the costs and benefits, but their distribution. A remark of E. P. Thompson could serve as a motto for the tradition of Marx and the Hammonds on this matter: "Enclosure (when all the sophistications are allowed for) was a plain enough case of class robbery."[13] This judgment on the equity of enclosure would require no comment in an inquiry

[11] W. E. Tate, *Nottinghamshire Parliamentary Enclosure*, Vol. V of the Record Series of the Thoroton Society (Nottingham: Thoroton Society, 1935). Compare Martin, "The Cost of Parliamentary Enclosure," in Jones, *Agriculture*, p. 135: an interval of one year during the early enclosures in Warwickshire widened to four or five by the end of the century.

[12] This and other costs of delay are neglected in studies of the costs of enclosure. The incentive to overwork land soon to become another's could be quite expensive. With yields of, say, 2½ quarters of wheat an acre and a price of £2 a quarter, a loss from this source of as little as, say, one-fifth of the normal yield for one year after the enclosure would add £1 an acre to the other costs (which Martin, "The Cost of Parliamentary Enclosure," reckons at something over £2 an acre before the inflation of the Napoleonic Wars).

[13] E. P. Thompson, *The Making of the English Working Class* (New York: Random House, 1963), p. 218.

into its efficiency were it not that the incentive to enclose could have been affected, at least theoretically, by the distribution as well as the size of the costs and benefits. The method of distributing them may have varied from year to year and from village to village in such a way that an equal social benefit in two villages would produce an enclosure in one and a continuation of the open fields in the other. An explanation of the timing of enclosure is necessary for measuring its impact on efficiency and the timing could have been affected by a mere shift in the incidence of the costs and benefits.

As much as enclosure may have hurt the poor, however, it is doubtful that the hurt was large enough, relative to the net gain to be achieved by the larger owners of the land, that it influenced their decision to enclose. This is because the poor were very poor: the value of their land and other rights was small. In consequence, an equitable procedure, which compensated them fully for their ancient rights, would have changed the net benefits accruing to those who had the power to set an enclosure in motion very little. As a first approximation, then, the issue of equity may be set to one side.

Another traditional perspective on enclosure may be set aside as well. Its growing popularity in the eighteenth century is scmetimes attributed to an increase in rationality, a new spirit of commercialism in farming, and the like, that is to say, to a realization that there were indeed benefits to be had from enclosure. At some point, perhaps in a residual role to account for phenomena that less speculative factors cannot explain, this hypothesis may have some use. But in its present form it is consistent with nearly any pattern of enclosure, and being consistent with any it is capable of being rejected by none. A hypothesis that cannot be put in jeopardy by facts is not an attractive one with which to begin.

The approach taken here is to suppose that the benefits, like the costs, varied from year to year and from village to village. When the benefits exceeded the costs a village was enclosed. In any one year after enclosure the social benefit to be set against the social costs was the value of the increased output achieved, that is to say, the product of the price of agricultural output and the increase in that output attributable to enclosure. What motivated men to enclose, of course, was not the net benefit for one year alone, but the expectation of a stream of benefits, and both the

costs and benefits, therefore, must be discounted back to the year in which the enclosure was set in motion. The prices relevant to the decision to set an enclosure in motion, although not those relevant to its social benefit considered after the event, are the prices expected to obtain in the future, not those that actually obtained in the future—the two would be the same only if men's expectations were perfectly fulfilled, which they seldom are. In brief, then, it is supposed that the rate of enclosure was governed by the present discounted value of the net benefits expected to be achieved and the capital value of the social gain is to be calculated from the present discounted value of the net benefits actually achieved.

These are familiar notions. It is a commonplace, for example, that the decision to enclose depended on expectations. Expectations on the course of future prices can be given a concrete representation by making them depend on statistics of present and past prices, on the reasonable assumption that this is the information farmers in fact used to assess their prospects. Past runs of wet or dry weather could be included as well, in the test of their influence, as that of prices, being how much they contribute to the statistical explanation of the timing of enclosure. It is a commonplace, too, that the prices of agricultural output are relevant to explaining the timing and that, in particular, their sharp rise during the Napoleonic Wars had much to do with the accompanying spurt in enclosure. It is, however, perhaps less of a commonplace to emphasize that what matters is the rise in prices relative to the costs of enclosure. The benefits of enclosure and therefore the amount that men are willing to pay to accomplish it may rise, but may nonetheless be offset by a rise in its cost, from a general inflation of prices or from an inelasticity in the supply of commissioners, surveyors, and other inputs that found much of their employment in enclosures. The rise in the price of wheat during the Napoleonic Wars, which is sometimes considered sufficient by itself to explain the spurt of enclosures, is less impressive when compared with the rise in the other prices.[14] To

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14 "Other prices" are meant here to stand as a rough proxy for the costs of enclosure. The model of investment used here is a knife-edge one, because it supposes that any excess of benefits over costs, however small, will prompt an enclosure. A more realistic model would admit that large excesses are more potent than small ones. If this emendation proves its worth in the statistical work it will imply another: since £1000 of benefit net of cost is the same amount in real terms as £2000 of

use a fruitful analogy, the rate of enclosure depended on both demand and supply, not on demand alone.

Prices are one component in the demand for enclosure, the increase in physical output another. If it were not so difficult to measure the loss of efficiency in the open field system, it would be possible to specify the source and magnitude of the expected increase in output and to relate it to the varying conditions of technology, soil, weather, major crops, and tenurial arrangements. Unfortunately, what is known directly about the loss of efficiency and the gain to be expected from eliminating it is only qualitative: for example, it is known that, other factors held constant, enclosure for pasture was more beneficial than enclosure for tillage. The vagueness of this information would be no obstacle to quantitative analysis if there were statistics on the agricultural output of villages before and after enclosure, but in general there is not. Although yields per acre do not appear to have increased during the eighteenth century, it is difficult to decide how much and still more difficult to allocate the increase to specific regions and times.

The increased output of a recently enclosed village, however, had to accrue in the first instance as income to its occupants, and this fact provides a way around the lack of information on output. An enclosure increased the value of all factors of production by increasing the output to be shared among them. Since labor and capital were mobile, the increase in their productivity would reveal itself in an increase in their employment, not an increase in their prices: if they were paid more, more would flow into the village, and continue to flow until the previous wages of labor and returns to capital were reestablished. It is difficult, although not impossible, to find evidence on the increase in the amount and value of employment of capital and labor after enclosure. For land, however, the situation is very different, both theoretically and evidentially. The value of land was increased by the direct increase in its productivity arising from enclosure and by the indirect increase arising from the larger amounts of complementary labor and capital employed. Land cannot flow from one village to another in response to higher returns, clearly, and in consequence whatever portion of the increased output from enclosure accrued to the factor

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benefit net of cost if the general price level has doubled between the two, the benefit itself will have to be deflated by the general price level.

land would reveal itself entirely in an increase in rent. The magnitude of the rise in rents after the enclosure of a village is relatively easy to observe. A rough average from the great variety of sources that give statistics on rents is a doubling of rents per acre after enclosure. The increase in rent, then, is known in a general way, can often be known in detail for particular villages, and can be used as an estimate (although biased downwards by not including the value of the increased employment of the other, mobile factors of production) of the increase in the value of output resulting from enclosure.

The evidence of the increase in rents requires careful handling, for it is not perfectly free of extraneous elements. Any fortuitous influence of variations in the price of agricultural products at the time of an enclosure must be removed from the rent figures, although this is not difficult to do. When treating a large group of enclosures together the influence of the enclosures themselves on prices must be removed as well. For individual enclosures, of course, this is not a problem, each village's output being a trivial portion of the relevant market for agricultural products as a whole. It is more difficult to correct for the influence on rents of agricultural improvements made at the time of an enclosure but neither related to it causally nor included in its costs. The simple solution of examining only those enclosures that were not accompanied by such improvements is available, but wastes evidence. A more economical solution would be to remove the influence of the improvements directly, although of necessity crudely.

Still another difficulty is that rents before an enclosure might not measure the true value of the land because long leases had been arranged during an earlier period of low agricultural prices. Since leases were annulled by enclosure the increase in rent might measure to some extent a mere adjustment of the rent to appropriate levels rather than a real increase in the productivity of the land (if agricultural prices have been falling, of course, the effect is reversed). In other words, the enclosure would present the landlords with an opportunity to repudiate the bad wagers they had made in earlier years that prices would not rise. The significance of this effect depends on the length of leases in a village to be enclosed and the course of prices in the preceding years. When long leases are common some allowances must be made for them in

the explanation of the rate of enclosure. The enclosures of the Napoleonic Wars, for example, probably had some element of renegotiation of leases in them. But as long as the prevalence of long leases can be estimated the adjustment in the reasoning is not difficult to make.

With these reservations, then, the observed increases in rent can serve as an estimate of the increase in output produced by an enclosure. It is strictly speaking a lower bound estimate, but can be expected to move in proportion to the increase in output as a whole. It can therefore play the same role in the analysis of the demand side of enclosure as costs play in the analysis of the supply side. Its variation can be related statistically to yearly variation in prices and interest rates and to regional variation in soil type, dominant crop, and so on, just as the variation in the cost of enclosure can be related to the progress of parliamentary procedures and to differences in the sizes of villages. The complete model brings the two together and permits the relevant historical experiments to be performed.

V

Some of the information given above can be used in a brief and crude experiment that may illustrate the promise of the complete model. If rents doubled on the 14 million or so acres enclosed after 1700, assuming as a low estimate that they earned typically a rent of 10 shillings an acre before enclosure (this before the inflation of the Napoleonic Wars), the increase in rent yields a lower bound on the increase in the value of agricultural output of around £7 million each year. Only opportunity costs need to be subtracted from this total (transfers of income, although they affect the rate of enclosure, do not detract from its social benefit), which may be put at around £2 an acre for each enclosure. If they were put higher it would matter little for the results, because to convert this capital sum into a stream of income comparable to the yearly increase in output it must be multiplied by the interest rate. Conceding that the rate of interest on consols, typically well under 5 percent, is a riskless rate and therefore too low, one might still doubt that the relevant rate was much above 10 percent. The 14 million acres enclosed, then, resulted in a stream of income foregone of (£2) (14 million) (.10), or £2.8 million each year. Therefore, the net gain

to national income, if one had the temerity to ignore the many qualifications necessary in view of the argument of this essay, could be put at around £4.2 million a year. Considering that the figure is meant to be very much a lower bound it is a respectable order of magnitude for a mere shift in the distribution of property rights: it is 3 or 4 percent of national income in 1970, for example; or roughly a 7 percent increase in the productivity of agriculture. To put the matter another way, the return to enclosure was high: an expenditure of £2 an acre (ignoring here transfer costs) yielded an increased rent accruing to the landlord of 10 shillings in each year following, for a rate of return of 25 percent per year.[15]

Whether or not the results of this crude experiment will be confirmed by the more refined ones proposed earlier remains to be seen. The refinements require more information, particularly a usable sample of the history of enclosure in a good number of villages, complete with the villages' topography and soil types, their size, their tenurial arrangements, and estimates of the costs and benefits of their enclosures. The constraints on the drawing of such a sample are many, for the records are often incomplete even when they have survived. And there is, of course, a large gap between constructing a model of enclosure and showing that a particular form of it is true. What can be claimed at this point, to use an appropriate metaphor, is that the ground has been cleared, if not plowed and harrowed, and with sufficient seed the harvest of historical insight can be ample.

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[15] In this form the calculation has a long history. See Arthur Young, *Agricultural Survey of Lincolnshire* (1799), pp. 77, 83; Gilbert Slater, *The English Peasantry and the Enclosure of Common Fields* (London: Constable, 1907), p. 262 ff; W. E. Tate, "The Cost of Parliamentary Enclo·ure in England (With Special Reference to the Country of Oxford)," *Economic History Review*, 2d ser., V (1953), 265; and, most recently, G. E. Mingay, *English Landed Society in the Eighteenth Century* (London: Routledge & Kegan Paul, 1963), p. 183.

approaches 'are here to stay', and predicts an increasing interdependence between the new and the old work.[1]

The Findings

The considerable impact of the new economic history on research in the United States is due primarily to the novelty of its substantive findings. If cliometrics merely reproduced the conclusions of previous scholarship, its methods would be of trivial consequence. However, the studies of the new economic historians have substantially altered some of the most well-established propositions of traditional historiography. They have also yielded knowledge that was hitherto considered unobtainable concerning institutions and processes central to the explanation of American economic development. I cannot within the compass of this paper do justice to the many studies produced by the new economic historians during the past decade. But I will attempt to summarize briefly some typical examples of their work.[2]

The Economics of Southern Slavery

One of the first, and one of the most influential, reinterpretations of the new economic history concerns the effect of slavery on the course of economic development in the South prior to the Civil War. Until recently most history books portrayed the ante-bellum South as an economically backward agricultural region that stagnated under the burden of the plantation system. By the eve of the war, it was held, slavery had become unprofitable and hence the system was moribund. Slavery was kept temporarily in existence by the transitory resolve of a class long accustomed to its peculiar social institutions.[3]

This view was sharply challenged in a paper by Alfred H. Conrad and John R. Meyer.[4] They rejected as inadequate the evidence usually presented to support the proposition that the profits of slaveowners were declining. The contention that slavery was unprofitable rested largely on the fact that the prices of slaves had risen more rapidly than the prices of the commodities that slaves produced. Conrad and Meyer pointed out that this divergency did not necessarily imply declining profits, for the productivity of slaves might have risen by an amount sufficient to maintain the original level of profits. They further argued that from an economic point of view slaves were a capital good and hence that one could compute the rate of return on an investment in them by solving the standard equation for the capitalization of an income stream; that is, by finding the rate of return which equated the price of slaves

[1] Redlich, '"New" and 'Traditional', pp. 491-95.

[2] For representative selections of essays in the new economic history, see Robert W. Fogel and Stanley L. Engerman (eds.), *The Reinterpretation of American Economic History* (New York: Harper and Row, Spring 1967); and Andreano, *New Views*. For a more popular, more interpretative survey see Douglass C. North's *Growth and Welfare in the American Past: A New Economic History* (Englewood Cliffs: Prentice-Hall, 1966).

[3] Cf. Harold D. Woodman, 'The Profitability of Slavery: A Historical Perennial', *Journal of Southern History*, XXIX (August 1963), 302-25; and Stanley L. Engerman, 'The Effects of Slavery on American Economic Growth', *The Reinterpretation*, Fogel and Engerman.

[4] Conrad and Meyer, *The Economics*, chapter 3.

to the discounted value of the stream of annual earnings derived from their employment.

Conrad and Meyer divided the slave economy into two sectors. The first was described by a production function that related the male slaves to the output of such staples as cotton, sugar and corn. The second was a capital-goods sector in which female slaves were used to produce new slaves. Conrad and Meyer then went on to estimate separate rates of return on slaves of each sex. The computation of the return on male slaves was the simpler case. They first derived the average capital cost per slave including not only the price of a slave, but also the average value of the land, animals and equipment used by a slave. Estimates of gross annual earnings were then built up from data on the price of cotton and the physical productivity of slaves. The net figure was obtained by subtracting the maintenance and supervisory costs for slaves from gross earnings. The average length of the stream of net earnings was determined from mortality tables. With these estimates Conrad and Meyer computed rates of return on male slaves and found that for the majority of ante-bellum plantations the return varied between 5 and 8 per cent, depending on the physical yield per hand and the prevailing farm price of cotton. On the farms in poor upland pine country or in the exhausted lands of the eastern seaboard the range of rates was merely 2 to 5 per cent. However, in the 'best lands of the new Southwest, the Mississippi alluvium and the better South Carolina and Alabama plantations' rates ran as high as 10 to 13 per cent.[1]

The computation of the rate of return on female slaves was somewhat more complicated. Conrad and Meyer had to take account not only of the productivity of a female in the field, but of such additional matters as the productivity of her offspring between their birth and the time of their sale; maternity, nursery and rearing costs; and the average number of offspring. Noting that very few females produced less than five or more than ten children that survived to be sold, Conrad and Meyer computed lower and upper limits on the rate of return. These turned out to be 7·1 and 8·1 per cent respectively. Thus, planters in the exhausted lands of the upper South who earned only 4 or 5 per cent on male slaves, still were able to achieve a return on their total operation equal to alternative opportunities. They did so by selling the offspring of females to planters in the West, thus earning rates of 7 to 8 per cent on the other half of their slave force. Proof of such a trade was found not only in the descriptions of contemporaries, but also in the age structure of the slave population. The selling states had a significantly larger proportion of persons under 15 and over 50 while the buying states predominated in slaves of the prime working ages.

[1] An alternate approach to the estimation of the return on male slaves is contained in Robert Evans, Jr. 'The Economics of American Negro Slavery', *Aspects of Labor Economics*, H. Gregg Lewis (ed.), Conference of Universities - National Bureau Committee for Economic Research (Princeton University Press, 1962), pp. 185-243. As with other capital goods, there was a market for the rental of slaves. Evans argued that the average annual hire price represented a good estimate of the annual net earnings on the investment in a male slave. He reduced the annual hire price for slaves of a given age by the proportion of the cohort that died during the course of the year. In so doing, Evans avoided the assumption that all slaves lived the average length of life. The result of his computation was a return of over 10 per cent during most of the years from 1830 through 1860.

Of the many studies in the economics of slavery stimulated by the pioneering work of Conrad and Meyer, the most important was the one by Yasukichi Yasuba.[1] Yasuba pointed out that in order to evaluate the viability of the slave system as a whole, rather than merely the viability of slavery in a given region or occupation, one had to equate the stream of net income from slaves not with their market price, but with their cost of production – that is, with the net cost of rearing slaves. A discrepancy between the price and the cost of producing capital goods in a given industry ordinarily will not last very long.[2] The existence of an unusually high profit – of economic rent – will induce new capital-producing firms to enter or old firms to expand production until the rent is eliminated, until the market price of the capital good falls to its cost of production.

In the case of slaves, however, the demand curve for them shifted outward more quickly than supply curve. The lag in supply was due partly to the ban against the importation of slaves after 1808 and partly to the fact that the domestic expansion of supply was limited by biological and cultural factors. As a consequence of these restrictions, the rent on slaves increased over time. Yasuba estimates that during the quinquennia of 1821-25, the average capitalized rent amounted to $428 out of an average slave price of $736, the balance representing the net cost of rearing the slave to maturity. In other words, during 1821-25 capitalized rent represented 58 per cent of the market price of slaves. By 1841-45 the capitalized rent was 72 per cent of the price of slaves and by 1851-55 it was nearly 85 per cent.

By showing the existence of a large and rising capitalized rent in the price of slaves over the forty years leading up to the Civil War, Yasuba effectively demonstrated the economic viability of the slave system. Moreover, the fact that Conrad and Meyer computed a return based on the market price rather than on the cost of producing slaves means that they underestimated the return to slavery as a system. Indeed, their computation showed only that slave prices adjusted so that investors who wanted to buy into the slave system could, on average, expect to earn merely the market rate of return.

Although slavery was a viable economic system, it could nevertheless have thwarted economic growth in the south by reducing the saving rate or by stifling entrepreneurship. Historians have long held that because of slavery, planters acquired extravagant tastes which led them to squander their income on high living. Slavery is also supposed to have bred an irrational attachment to agriculture. As a consequence, it is said, planters shunned opportunities for profit in manufacturing.

The alleged stagnation of the ante-bellum South has been thrown into doubt by recent findings. The work of Conrad, Meyer, Yasuba and others strongly suggests that the southern decision to slight manufacturing was not an absurd

[1] Yasukichi Yasuba, 'The Profitability and Viability of Plantation Slavery in the United States', Economic Studies Quarterly, XII (September 1961), 60-67; reprinted in Fogel and Engerman, The Reinterpretation. Richard Sutch independently arrived at a position similar to Yasuba's in 'The Profitability of Ante-Bellum Slavery – Revisited', Southern Economic Journal, XXXI (April 1963). See also the discussion by North in Growth and Welfare, chapter 7, and Engerman's 'The Effects of Slavery'.
[2] The cost of production includes the normal rate of profit.

eccentricity. It now appears to have been a rational response to profits in plantation agriculture, that were considerably above alternative opportunities. Moreover, estimates of regional income constructed by Richard Easterlin indicate that per capita income grew as rapidly in the ante-bellum South as in the rest of the nation, averaging about 1·5 per cent per annum.[1]

The retarded development of the South during the last third of the nineteenth century and the first half of the twentieth was due not to stagnation during the slave era, but to the devastation caused by the Civil War. As Stanley Engerman points out, if ante-bellum growth-rates had continued through the war decade, southern per capita income would have been twice the level that actually prevailed in 1870. So disruptive was the war that it took the South some thirty years to regain the per capita income of 1860 and another sixty years to reach the same relative position in national per capita income that it enjoyed at the close of the ante-bellum era.[2] The case for the abolition of slavery thus appears to turn on issues of morality and equity rather than on the inability of a slave system to yield a high rate of economic growth.

Technology and Productivity

While the issue of slavery looms large in the interpretation of American economic history, it is of limited relevance outside of that context. Of wider interest to European scholars is the new work on technology and productivity. From the time of Arnold Toynbee through that of Paul Mantoux and down to the present day, economic historians have made technological change embodied in specific machines and processes the sine qua non of economic advance. As a result of their work every schoolboy has been taught that it was such inventions as the spinning jenny, the power loom, the reverberatory furnace, the rolling mill, the steam-engine and the railroad that brought about the industrial revolutions of England, France, Germany and the United States. Yet despite a considerable literature which illuminates the history of machines and their employment, we still have much to learn about the precise effects of particular innovations on productivity and about the process by which a given innovation spreads throughout an industry.

It is to the solution of these and related questions that much of the research of the new economic historians has been directed. This work falls into four main categories. The first is the attempt to 'explain' observed increases in productivity – that is, to distribute the responsibility for the increase in productivity among various factors. Typical of this approach is William Parker's analysis of wheat production.[3] He finds that between 1840 and 1911 labour productivity in wheat grew by more than three-fold. Of this increase he attributes the lion's share, 60 per cent, to mechanization; 17 per cent to the change in the regional locus of production; 16 per cent to the interaction of mechani-

[1] Richard A. Easterlin, 'Regional Income Trends, 1840-1950', American Economic History, Seymour E. Harris (ed.) (New York: McGraw-Hill, 1961), pp. 525-47. Stanley L. Engerman, 'The Economic Effects of the Civil War', Explorations in Entrepreneurial History (forthcoming).
[2] Engerman, 'The Economic Effects'.
[3] William N. Parker, 'Productivity Growth in Crop Production', forthcoming in Volume 30 of Studies in Income and Wealth, National Bureau of Economic Research.

zation and regional relocation; and the remaining 7 per cent to other factors. Improvements in machines had their greatest impact on harvesting and post-harvesting operations. Professor Parker estimates that the reaper and thresher alone accounted for 70 per cent of the gain from mechanization or over 40 per cent of the increase in overall productivity.

It would be wrong to infer from Parker's study that the new work gives warrant to the preoccupation with technological change embodied in equipment that characterizes so much of the past literature of economic history. Parker's study aims not at extolling machines, but at identifying all the important factors that explain productivity advance in agriculture. It so happens that for the given period and crop, the development of two machines dominates the explanation. Other studies produced quite different results. Thus, new equipment plays virtually no role in Douglass North's explanation of the 50 per cent fall in the cost of ocean transportation that he finds for the 250-year period between 1600 and the middle of the nineteenth century. Almost all of the decline is explained by two other factors: the elimination of piracy and the increase in the size of the market. The elimination of piracy substantially reduced manning requirements since military personnel were no longer needed. The increase in the size of the market lowered shipping costs by encouraging the concentration of surpluses in central markets. This development considerably reduced the amount of time ships spent in port acquiring a cargo.[1]

The second category consists of studies aimed at explaining the growth of particular industries. One of the best examples of this type of work is Robert Brooke Zevin's analysis of the growth of the American cotton textile industry prior to 1860.[2] As Zevin points out, the seventeen years from 1816 to 1833 are the most interesting period in the early history of the industry. During this span the output of cotton cloth expanded from 840,000 to 231,000,000 yards, an increase of over 280 times. Abstracting from cyclical considerations, Zevin puts the average annual rate of growth in production at 17·1 per cent. He finds that one-third of this expansion was due to an increase in demand stimulated mainly by the growth of the urban and western populations. The remaining two-thirds was due to a downward shift in the supply curve. Zevin explains the change in supply by improvements in textile machinery, the fall in the price of raw cotton and the growth of skilled technicians. However, the improvement of machinery was the least important of the factors. It accounted for only 17 per cent of the expansion of cloth production. The fall in the price of raw cotton accounted for 28 per cent and the growing pool of skilled technicians for the remaining 22 per cent.

Zevin's study, taken in conjunction with others, points to the inadequacy of new machinery and other forms of equipment as the sole, or even the primary explanation of growth in the main manufacturing industries of Europe and

[1] Douglass C. North, 'Determinants of Productivity in Ocean Shipping', *The Reinterpretation*, Fogel and Engerman.
[2] Robert Brooke Zevin, 'The Growth of Cotton Textile Production after 1815', *The Reinterpretation*, Fogel and Engerman.

America during the last two centuries. The preoccupation with machines has led to an underestimation of the role of demand in the promotion of industrial growth. It has also resulted in the slighting of such determinants of supply as the quality of labour, the stock of skills, the efficiency of industrial organization, and economies of scale.[1]

Analyses of the diffusion of technological innovations fall into the third category. The diffusion problem promises to be one of the most popular topics of the new economic history. Peter Temin's explanation of the spread of anthracite and coke blast furnaces has already become well known.[2] A more recent contribution is a paper on reapers by Paul David.[3] Although the reaper was invented in the 1830's, its diffusion proceeded at a very slow pace for two decades. The 'first major wave of popular acceptance' of the innovation 'was concentrated in the mid-1850's'. The literature is ambiguous regarding the cause of this upsurge. Various writers have stressed the rise in wheat prices and the scarcity of farm labour as factors. However, these accounts do not indicate the process by which the rise in wheat prices led to an increased demand for reapers.

David points out that if, on the industry level, the supply curve of labour is less elastic than the supply of reapers, a rise in the price of wheat will raise the price of farm labour relative to the price of reapers. He also notes that reapers had to be purchased rather than rented. Thus, even though the annual cost of a reaper to a farmer was independent of farm size, his average reaper cost, per acre harvested, fell as the number of acres in small grains increased, until the cutting capacity of a single machine was reached. By contrast, the cost per acre of reaping by the old method was constant because, to the farmer, the supply of labour was perfectly elastic and there were no economies of scale in the old method.

The foregoing considerations suggest the existence of a threshold function that relates the farm size at which it just paid to introduce the reaper, to the ratio between the price of a reaper and the wage of farm labour. David estimates the parameters of this function and finds that at the beginning of the fifties, the relationship of reaper and labour prices was such that it became profitable to introduce the reaper only on farms with 46 or more acres in small grains. At the time, however, the average number of acres in such grains per farm was about 25. By the mid-fifties the cost of reapers had fallen relative to the price of labour. The decline reduced the threshold size to just 35 acres. At the same time the average acreage in small grains rose to 30. Thus, within a period of about five years, the gap between the threshold farm size and the average actual farm size was reduced by over 75 per cent. It is the precipitous

[1] Cf. North, *Growth and Welfare*, pp. 6–10.
[2] Peter Temin, 'A New Look at Hunter's Hypothesis about the Antebellum Iron Industry', *American Economic Review*, LIV (May 1964), 344–51; Peter Temin, *Iron and Steel in Nineteenth-Century America* (Cambridge, Mass.: M.I.T. Press, 1964), chapter 3.
[3] Paul David, 'The Mechanization of Reaping in the Ante-Bellum Midwest', *Industrialization in Two Systems: Essays in Honor of Alexander Gerschenkron*, Henry Rosovsky (ed.) (New York: John Wiley and Sons, 1966), pp. 3–39.

closing of this gap that explains the accelerated diffusion of reapers during the mid-fifties.

The final category of studies on technology and productivity consists of works which attempt to evaluate the net social benefit of particular innovations. My book, *Railroads and American Economic Growth*, belongs to this category.[1] Estimation of the net benefit of railroads involves a comparison between the actual level of national income and the level that would have obtained in the absence of railroads. The amount of national income in the absence of railroads cannot be computed directly. It is necessary to construct a hypothetico-deductive model on the basis of which one can infer, from those conditions that were actually observed, a set of conditions that never occurred.

In my book I attempted to construct such a model for the year 1890. The conceptual foundation of the model is the 'social saving' of railroads. The social saving in any given year is defined as the difference between the actual cost of shipping goods in that year and the alternative cost of shipping exactly the same goods between exactly the same points without railroads. This cost differential is in fact larger than the 'true' social saving. Forcing the pattern of shipments in a non-rail situation to conform to the pattern that actually existed is equivalent to the imposition of a restraint on society's freedom to adjust to an alternative technological situation. If society had had to ship by water and wagon without the railroad it could have altered the geographical locus of production in a manner that would have economized on transport services. Further, the sets of primary and secondary markets through which commodities were distributed were surely influenced by conditions peculiar to rail transportation; in the absence of railroads some different cities would have entered these sets, and the relative importance of those remaining would have changed. Adjustments of this sort would have reduced the loss of national income occasioned by the absence of the railroad.

The computation of the social saving required both estimates of the direct payments that would have been made for boat and wagon transportation services and estimates of such indirect costs as cargo losses in transit, the expence resulting from the time lost when using a slow medium of transportation and the expence of being unable to use waterways during the winter months. Regression analysis was used to derive the cost functions of boats. The water rates that would have obtained in the absence of railroads were computed from these functions. The economic losses caused by slow service and by the vagaries of the weather were quantified by estimating the cost of expanding inventories to a size that would have permitted businesses to maintain their normal temporal pattern of distribution. The expected cargo loss was derived from insurance rates.

Because of the large amounts of data that had to be processed, my study was restricted to the social saving attributable to the transportation of agricultural commodities. The amount of this saving was estimated under three different assumptions regarding the possibility of technological adaptation to the absence of railroads. The first was that society would have relied on only the

[1] Baltimore: Johns Hopkins Press, 1964.

canals and roads that actually existed in 1890. The second was that at least 5,000 miles of feasible and, in the absence of railroads, highly profitable canals would have been built. The third was that common roads would have been improved. Under the first of these assumptions the agricultural social saving of railroads was $373,000,000 or 3·1 per cent of gross national product in 1890. The extension of canals and improvements of roads would have reduced the social saving to 1·8 per cent of G.N.P. It is interesting to note that the two main benefits achieved by the railroad were the reduction in inventories and the reduction in wagon transportation. Together these accounted for about 80 per cent of the social saving.

Albert Fishlow's penetrating, many-sided study of railroads during the *ante-bellum* era contains an estimate of the social saving for 1859.[1] His computation covers not merely agricultural commodities, but all other freight and all passenger traffic. Fishlow finds that the social saving of railroads was about $175,000,000 or 4 per cent of G.N.P. Of this total, agricultural commodities account for roughly one-quarter, other freight for another third, and passenger service for the balance. In comparing Fishlow's result with mine, it is important to keep in mind that Fishlow's calculation is for the case in which there would have been no technological adaptation to the absence of railroads. Given that assumption, the correspondence between our findings is extremely close. A computation of the 1859 social saving for the case of limited technological adaptation to the absence of railroads is still to be performed.

I should like to conclude this section of my paper in the way that I began it — by stressing the inadequacy of my survey of the work of the new economic historians. Among the important contributions that I have slighted are studies by Robert Gallman on Southern agriculture, Jeffrey Williamson on the determinants of urbanization before the Civil War, Stanley Lebergott on the role of labour in nineteenth-century economic growth, John Bowman on the agricultural depression of the Gilded Age, and Lance Davis on the evolution of capital markets.

The Methods

The methodological hallmarks of the new economic history are its emphasis on measurement and its recognition of the intimate relationship between measurement and theory. Economic history has always had a quantitative orientation. But much of the past numerical work was limited to the location and simple classification of data contained in business and government records. With the exception of the excellent work on the construction of price indexes, relatively little was done to transform this information in ways that would shed light on 'rigorously defined concepts of economic analysis'[2] until the development of national income accounting techniques. The pioneers of the

[1] Albert Fishlow, *American Railroads and the Transformation of the Ante-Bellum Economy* (Cambridge, Mass.: Harvard University Press, 1965), chapter 2.
[2] Simon Kuznets, 'Summary of Discussion and Postscript', *Journal of Economic History*, XVII (December 1957), 553.

massive statistical reconstructions embodied in national income accounts were not economic historians, but empirical economists such as Simon Kuznets in the United States, J. R. N. Stone and Phyllis Deane in Great Britain, and François Perroux and Jean Marczewski in France. While economic historians made considerable use of national income measures, they did not immediately attempt to extend the process of statistical reconstruction to the vast array of issues in their domain. Most discussions of economic historians remained primarily qualitative with numerical information used largely as illustration.

The new economic historians are trying to end this long-existing void in measurement. They have set out to reconstruct American economic history on a sound quantitative basis. This objective is extremely ambitious and the obstacles to its fulfilment are numerous. The most frustrating problem is the paucity of data. Information bearing on many vital institutions and processes in the past was either never collected or has been lost. In still other cases the data are extant, but are so numerous or held in such a form that their retrieval without the aid of modern statistical methods would be prohibitively expensive.

As a consequence, statistics and mathematics are widely employed by the new economic historians. Regression analysis is perhaps the most frequently used tool. It is the principal device on which Albert Fishlow relied in his reconstruction of the investment of railroads during the *ante-bellum* era.[1] Jeffrey Williamson makes heavy use of it in his study of urbanization.[2] And Paul MacAvoy employs a lagged form of the regression model in order to determine the relationship between grain prices and transportation rates.[3] Examples of the usefulness of other mathematical methods include William Whitney's employment of input-output analysis to measure the effect of tariffs on the rise of manufacturing[4] and James K. Kindahl's application of the hypergeometric distribution to estimate, from two incomplete lists, the total number of state banks that were in operation immediately after the close of the Civil War.[5]

Some historians have held that there is no point in applying powerful statistical methods to economic history because the available data are too poor. In actual practice, the correlation often runs the other way. When the data are very good, simple statistical procedures will usually suffice. The poorer the data, the more powerful are the methods which have to be employed. Nevertheless, it is often true that the volume of data available is frequently below the minimum required for standard statistical procedures. In such instances the

[1] Fishlow, *American Railroads*, chapter 3 and Appendix B.
[2] Jeffrey G. Williamson, '*Ante-bellum* Urbanization in the American Northeast', *Journal of Economic History*, XXV (December 1965), 592–608; Jeffrey G. Williamson and Joseph A. Swanson, 'The Growth of Cities in the American Northeast, 1820–1870' (mimeographed).
[3] Paul W. MacAvoy, *The Economic Effects of Regulation: The Trunk-Line Railroad Cartels and the Interstate Commerce Commission before 1900* (Cambridge, Mass.: M.I.T. Press, 1965).
[4] William S. Whitney, *The Structure of the American Economy in the Late Nineteenth Century* (dissertation in progress for Harvard University).
[5] James K. Kindahl, 'The Economics of Resumption: The United States, 1865–1879' (unpublished doctoral dissertation, University of Chicago, 1958); published without statistical appendices as 'Economic Factors in Specie Resumption: The United States, 1865–79', *Journal of Political Economy*, LXIX (February 1961).

crucial determinant of success is the ability of the investigator to devise methods that are exceedingly efficient in the utilization of data – that is, to find a method that will permit one to achieve a solution with the limited data that are available.

The way in which economic theory can be employed to circumvent the data problem is illustrated by Paul David's study of mechanical reapers. Utilization of regression analysis to compute a threshold function for reapers would have required county data on the employment of reapers by farm size, on the delivered price of reapers, and on the average wage of labour. Unfortunately, such information was not available for counties. To surmount the problem, David turned to the theory of production. He first noted that a farmer would be indifferent to the choice between mechanized and hand reaping when the cost of cutting grain on a specified acreage was the same by both methods. He also noted the absence of economies and diseconomies of scale in the employment of hand labour. These specifications, together with two linear approximations, yielded a threshold function with only three parameters. The parameters were the rate of depreciation, the rate of interest and the rate of substitution between reapers and man-days of labour. The data required to estimate these parameters were available.[1]

The union between measurement and theory is most clearly evident when one attempts to establish the net effect of innovations, institutions or processes on the course of economic development. The net effect of such things on development involves a comparison between what actually happened and what would have happened in the absence of the specified circumstance. However, since the counterfactual condition never occurred, it could not have been observed, and hence is not recorded in historical documents. In order to determine what would have happened in the absence of a given circumstance the economic historian needs a set of general statements (that is, a set of theories or a model) that will enable him to deduce a counterfactual situation from institutions and relationships that actually existed.

This is precisely the problem when one attempts to evaluate the frequent claim that railroads extended the area of commercial agriculture in the United States. It is, of course, true that the area of commercial agriculture and the construction of railroads expanded more or less simultaneously. However, it does not follow that railroads were a necessary condition for the commercial exploitation of the new lands. To settle the issue one must find a method of determining how much of the land actually settled after the advent of railroads would have been settled in their absence.

Without railroads the high cost of wagon transportation would have limited commercial agricultural production to areas of land lying within some unknown distance of navigable waterways. It is possible to use the theory of rent to establish these boundaries of feasible commercial agriculture in a non-rail society. Rent is a measure of the amount by which the return to labour and capital on a given portion of land exceeds the return the same factors could earn if they were employed at the intensive or extensive margins. Therefore, any plot

[1] David, 'The Mechanization', pp. 28–39.

of land capable of commanding a rent will be kept in productive activity. It follows that, even in the face of increased transportation costs, a given area of farm land will remain in use as long as the increased costs incurred during a given time period do not exceed the original rental value of that land.

Given information on the quantity of goods shipped between farms and their markets, the distances from farms to rail and water shipping points, the distance from such shipping points to markets, and the wagon, rail and water rates, it is possible to compute the additional transportation costs that would have been incurred if farmers attempted to duplicate their actual shipping pattern without railroads. In such a situation shipping costs would have risen not because boat rates exceeded rail rates, but because it usually required more wagon transportation to reach a boat than a rail shipping point. In other words, farms immediately adjacent to navigable waterways would have been least affected by the absence of rail service. The further a farm was from a navigable waterway the greater the amount of wagon transportation it would have required. At some distance from waterways the additional wagon haul would have increased the cost of shipping from a farm by an amount exactly equal to the original rental value of the land. Such a farm would represent a point on the boundary of feasible commercial agriculture. Consequently, the full boundary can be established by finding all those points from which the increased cost of shipping by alternative means the quantities that were actually carried by railroads is equal to the original rental value of the land.

This approach, it should be noted, leads to an overstatement of the land falling beyond the 'true' feasible boundary. A computation based on the actual mix of products shipped does not allow for adjustments to a non-rail technology. In the absence of railroads the mix of agricultural products would have changed in response to the altered structure of transportation rates. Such a response would have lowered shipping costs and hence extended the boundary. The computation also ignores the consequence of a cessation in agricultural production in areas beyond the feasible region on the level of prices. Given the relative inelasticity of the demand for agricultural products, the prices of such commodities would have risen in the absence of railroads. The rise in prices would have led to a more intensive exploitation of agriculture within the feasible region, thus raising land values. The rise in land values would have increased the burden of additional transportation costs that could have been borne and shifted the boundary of feasible commercial agriculture further away from water shipping points.[1]

The method outlined above is the one I used to establish the boundary of feasible commercial agriculture for 1890. It turns out that given only the active waterways of that year, at least 76 per cent of the land actually employed in agriculture would have remained employed in the absence of railroads. Moreover, a 5,000-mile extension of the canal system would have increased the land in commercial agriculture to 93 per cent of that actually cultivated. The theory of rent also enables one to infer which canals would have been socially profitable. It can be shown that a new canal would have been profit-

[1] For a more detailed discussion of the theoretical issues see Fogel, *Railroads*, chapter 3.

able if the land it brought into the feasible region had an 1890 value which exceeded the canals' construction cost by the present value of any additional wagon transportation that would have been incurred by the absence of railroads.[1]

According to Fritz Redlich, these attempts to answer counterfactual questions by the use of hypothetico-deductive models are the most novel and the most dubious methodological aspect of the new economic history. Professor Redlich argues that counterfactual propositions are fundamentally alien to economic history. He also believes that they are untestable and hence calls essays involving such propositions 'quasi-history'.[2]

However, if we are to exclude from history those studies which are based on counterfactual propositions, we will have to expurgate not only the new work, but much of the old work as well. The difference between the old and the new economic history is not the frequency with which one encounters counterfactual propositions, but the extent to which such propositions are made explicit. The old economic history abounds in disguised counterfactual assertions. They are present in discussions which either affirm or deny that tariffs accelerated the growth of manufacturing; in essays which argue that slavery retarded the development of the South; in debates over whether the Homestead Act made the distribution of land more equitable; in the contention that railroads expanded interregional trade; and in virtually every other discussion which makes a legal, social, technological, administrative or political innovation the cause of a change in economic activity. All of these arguments involve implicit comparisons between the actual state of the nation and the state that would have prevailed in the absence of the specified circumstance.

Indeed, the new economic historians have not been primarily engaged in launching new counterfactual propositions, but in making explicit and testing the ones they find in traditional history. One should not underestimate the task involved in demonstrating that comparisons which appear to be between events that actually occurred are in reality counterfactual propositions. Consider, for example, the arithmetic index of productivity popularized by John Kendrick. This measure of total factor productivity, now more than a decade old, is usually described as the ratio of an output index to a weighted index of inputs, where the weights are the shares of the factors in value added. However, a deft proof by Albert Fishlow shows that what appears to be purely a comparison of recorded circumstances is really a disguised comparison between the actual price of the output and the price that would have obtained in the absence of technological change.[3]

Since counterfactual propositions are merely inferences from hypothetico-deductive models, it follows that such propositions can be verified in at least two ways. The first involves the determination of whether the proposition asserted follows logically from its premises. The second requires a determination

[1] *Ibid.* pp. 79–84, 92–107.
[2] Fritz Redlich, '"New" and Traditional', pp. 486–87.
[3] Albert Fishlow, 'Productivity and Technological Change in the Railroad Sector, 1840–1910', forthcoming in Volume 30 of *Studies in Income and Wealth*, National Bureau of Economic Research.

of whether the assumptions of the model are empirically valid.[1] Most of the revisions of the new economic history follow from a demonstration that one or both of these conditions for valid inferences have been violated. As noted earlier, Conrad and Meyer overthrew Phillips's proposition that slavery was moribund by showing that his conclusion rested on the false assumption that a divergence between the rates of growth of slave and cotton prices implied a decrease in profits. On the other hand, as I attempted to demonstrate in another paper, one cannot rest the case for the indispensability of railroads to the total economy on evidence which shows that railroads had the power to crush particular firms on regions. This argument involves the fallacy of composition and hence gives rise to a *non-sequitur*.[2]

The foregoing suggests that the fundamental methodological feature of the new economic history is its attempt to cast all explanations of past economic development in the form of valid hypothetico-deductive models. This is another way of saying that the new generation seeks to continue an effort that was under way long before it appeared on the scene: namely the construction of economic history on the basis of scientific methods. If the new economic historians are able to advance that objective it will be partly because of what they have inherited from their predecessors and partly because they are the beneficiaries of a series of important developments in economic theory, in statistics and in applied mathematics.

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