The Problem of Social Cost

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I. THE PROBLEM TO BE EXAMINED

This paper is concerned with those actions of business firms which have harmful effects on others. The standard example is that of a factory the smoke from which has harmful effects on those occupying neighbouring properties. The economic analysis of such a situation has usually proceeded in terms of a divergence between the private and social product of the factory, in which economists have largely followed the treatment of Pigou in *The Economies of Welfare.* The conclusion to which this kind of analysis seems to have led most economists is that it would be desirable to make the owner of the factory liable for the damage caused to those injured by the smoke, or alternatively, to place a tax on the factory owner varying with the amount of smoke produced and equivalent in money terms to the damage it would cause, or finally, to exclude the factory from residential districts (and presumably from other areas in which the emission of smoke would have harmful effects on others). It is my contention that the suggested courses of action are inappropriate, in that they lead to results which are not necessarily, or even usually, desirable.

II. THE RECIPROCAL NATURE OF THE PROBLEM

The traditional approach has tended to obscure the nature of the choice that has to be made. The question is commonly thought of as one in which A inflicts harm on B and what has to be decided is: how should we restrain A? But this is wrong. We are dealing with a problem of a reciprocal nature. To avoid the harm to, B would inflict harm on A. The real question that has to be decided is: should A be allowed to harm B or should B be allowed to harm A? The problem is to avoid the more serious harm. I instanced in my previous article the case of a confectioner the noise and vibrations from whose machinery disturbed a doctor in his work. To avoid harming the doctor would inflict harm on the confectioner. The problem posed by this case was essentially whether it was worth while, as a result of restricting the methods of production which could be used by the confectioner, to secure more doctoring at the cost of a reduced supply of confectionery products. Another example is afforded by the problem of straying cattle which destroy crops on neighbouring land. If it is inevitable that some cattle will stray, all increase in the supply of meat can only

be obtained at the expense of a decrease in the supply of crops. The nature of the choice is clear: meat or crops. What answer should be given is, of course, not clear unless we know the value of what is obtained as well as the value of what is sacrificed to obtain it. To give another example, Professor George J. Stigler instances the contamination of a stream. If we assume that the harmful effect of the pollution is that it kills the fish, the question to be decided is: is the value of the fish lost greater or less than the value of the product which the contamination of the stream makes possible. It goes almost without saying that this problem has to be looked at in total *and* at the margin.

III. THE PRICING SYSTEM WITH LIABILITY FOR DAMAGE

I propose to start my analysis by examining a case in which most economists would presumably agree that the problem would be solved in a compeletely satisfactory manner: when the damaging business has to pay for all damage caused *and* the pricing system works smoothly (strictly this means that the operation of a pricing system is without cost).

A good example of the problem under discussion is afforded by the case of straying cattle which destroy crops growing on neighbouring land. Let us suppose that a farmer and cattle-raiser are operating on neighbouring properties. Let us further suppose that, without any fencing between the properties, an increase in the size of the cattle-raiser's herd increases the total damage to the farmer's crops. What happens to the marginal damage as the size of the herd increases is another matter. This depends on whether the cattle tend to follow one another or to roam side by side, on whether they tend to be more or less restless as the size of the herd increases and on other similar factors. For my immediate purpose, it is immaterial what assumption is made about marginal damage as the size of the herd increases.

To simplify the argument, I propose to use an arithmetical example. I shall assume that the annual cost of fencing the farmer's property is \$9 and the price of the crop is \$1 per ton. Also, I assume that the relation between the number of cattle in the herd and the annual crop loss is as follows:

NUMBER IN HERD (STEERS)	ANNUAL CROP LOSS (TONS)	CROP LOSS PER ADDITIONAL STEER (TONS)
1	1	1
2	3	2
3	6	3
4	10	4

Given that the cattle-raiser is liable for the damage caused, the additional annual cost imposed on the cattle-raiser if he increased his herd from, say, 2 to 3 steers is \$3 and in deciding on the size of the herd, he will take this into

account along with his other costs. That is, he will not increase the size of the herd unless the value of the additional meat produced (assuming that the cattle-raiser slaughters the cattle) is greater than the additional costs that this will entail, including the value of the additional crops destroyed. Of course, if, by the employment of dogs, herdsmen, aeroplanes, mobile radio and other means, the amount of damage can be reduced, these means will be adopted when their cost is less than the value of the crop which they prevent being lost. Given that the annual cost of fencing is $9, the cattle-raiser who wished to have a herd with 4 steers or more would pay for fencing to be erected and maintained, assuming that other means of attaining the same end would not do so more cheaply. When the fence is erected, the marginal cost due to the liability for damage becomes zero, except to the extent that an increase in the size of the herd necessitates a stronger and therefore more expensive fence because more steers are liable to lean against it at the same time. But, of course, it may be cheaper for the cattle-raiser not to fence and to pay for the damaged crops, as in my arithmetical example, with 3 or fewer steers.

It might be thought that the fact that the cattle-raiser would pay for all crops damaged would lead the farmer to increase his planting if a cattle-raiser came to occupy the neighbouring property. But this is not so. If the crop was previously sold in conditions of perfect competition, marginal cost was equal to price for the amount of planting undertaken and any expansion would have reduced the profits of the farmer. In the new situation, the existence of crop damage would mean that the farmer would sell less on the open market but his receipts for a given production would remain the same, since the cattle-raiser would pay the market price for any crop damaged. Of course, if cattle-raising commonly involved the destruction of crops, the coming into existence of a cattle-raising industry might raise the price of the crops involved and farmers would then extend their planting. But I wish to confine my attention to the individual farmer.

I have said that the occupation of a neighbouring property by a cattle-raiser would not cause the amount of production, or perhaps more exactly the amount of planting, by the farmer to increase. In fact, if the cattle-raising has any effect, it will be to decrease the amount of planting. The reason for this is that, for any given tract of land, if the value of the crop damaged is so great that the receipts from the sale of the undamaged crop are less than the total costs of cultivating that tract of land, it will be profitable for the farmer and the cattle-raiser to make a bargain whereby that tract of land is left uncultivated. This can be made clear by means of an arithmetical example. Assume initially that the value of the crop obtained from cultivating a given tract of land is $12 and that the cost incurred in cultivating this tract of land is $10, the net gain from cultivating the land being $2. I assume for purposes of simplicity that the farmer owns the land. Now assume that the cattle-raiser starts operations

on the neighbouring property and that the value of the crops damaged is $I. In this case $11 is obtained by the farmer from sale on the market and $1 is obtained from the cattle-raiser for damage suffered and the net gain remains $2. Now suppose that the cattle-raiser finds it profitable to increase the size of his herd, even though the amount of damage rises to $3; which means that the value of the additional meat production is greater than the additional costs, including the additional $2 payment for damage. But the total payment for damage is now $3. The net gain to the farmer from cultivating the land is still $2. The cattle-raiser would be better off if the farmer would agree not to cultivate his land for any payment less than $3. The farmer would be agreeable to not cultivating the land for any payment greater than $2. There is clearly room for a mutually satisfactory bargain which would lead to the abandonment of cultivation. * But the same argument applies not only to the whole tract cultivated by the fanner but also to any subdivision of it. Suppose, for example, that the cattle have a well-defined route, say, to a brook or to a shady area. In these circumstances, the amount of damage to the crop along the route may well be great and if so, it could be that the farmer and the cattle-raiser would find it profitable to make a bargain whereby the farmer would agree not to cultivate this strip of land.

But this raises a further possibility. Suppose that there is such a well defined route. Suppose further that the value of the crop that would be obtained by cultivating this strip of land is $10 but that the cost of cultivation is $11. In the absence of the cattle-raiser, the land would not be cultivated. However, given the presence of the cattle-raiser, it could well be that if the strip was cultivated, the whole crop would be destroyed by the cattle. In which case, the cattle-raiser would be forced to pay $10 to the farmer. It is true that the farmer would lose $1. But the cattle-raiser would lose $10. Clearly this is a

* The argument in the text has proceeded on the assumption that the alternative to cultivation of the crop is abandonment of cultivation altogether. But this need not be so. There may be crops which are less liable to damage by cattle but which would not be as profitable as the crop grown in the absence of damage. Thus. if the cultivation of a new crop would yield a return to the farmer of $1 instead of $2, and the size of the herd which would cause $3 damage with the old crop would cause $I damage with the new crop, it would be profitable to the cattle-raiser to pay any sum less than $2 to induce the farmer to change his crop (since this would reduce damage liability from $3 to $1) and it would be profitable for the farmer to do so if the amount received was more than $1 (the reduction in his return caused by switching crops). In fact, there would be room for a mutually satisfactory bargain in all cases in which change of crop would reduce the amount of damage by more than it reduces the value of the crop (excluding damage)—in all cases, that is, in which a change in the crop cultivated would lead to an increase in the value of production.

situation which is not likely to last indefinitely since neither party would want this to happen. The aim of the farmer would be to induce the cattle-raiser to make a payment in return for an agreement to leave this land uncultivated. The farmer would not be able to obtain a payment greater than the cost of fencing off this piece of land nor so high as to lead the cattle-raiser to abandon the use of the neighbouring property. What payment would in fact be made would depend on the shrewdness of the farmer and the cattle-raiser as bargainers. But as the payment would not be so high as to cause the cattle-raiser to abandon this location and as it would not vary with the size of the herd, such an agreement would not affect the allocation of resources but would merely alter the distribution of income and wealth as between the cattle-raiser and the farmer.

I think it is clear that if the cattle-raiser is liable for damage caused and the pricing system works smoothly, the reduction in the value of production elsewhere will be taken into account in computing the additional cost involved in increasing the size of the herd. This cost will be weighed against the value of the additional meat production and, given perfect competition in the cattle industry, the allocation of resources in cattle-raising will be optimal. What needs to be emphasized is that the fall in the value of production elsewhere which would be taken into account in the costs of the cattle-raiser may well be less than the damage which the cattle would cause to the crops in the ordinary course of events. This is because it is possible, as a result of market transactions, to discontinue cultivation of the land. This is desirable in all cases in which the damage that the cattle would cause, and for which the cattle-raiser would be willing to pay, exceeds the amount which the farmer would pay for use of the land. In conditions of perfect competition, the amount which the farmer would pay for the use of the land is equal to the difference between the value of the total production when the factors are employed on this land and the value of the additional product yielded in their next best use (which would be what the farmer would have to pay for the factors). If damage exceeds the amount the farmer would pay for the use of the land, the value of the additional product of the factors employed elsewhere would exceed the value of the total product in this use after damage is taken into account. It follows that it would be desirable to abandon cultivation of the land and to release the factors employed for production elsewhere. A procedure which merely provided for payment for damage to the crop caused by the cattle but which did not allow for the possibility of cultivation being discontinued would result in too small an employment of factors of production in cattle-raising and too large an employment of factors in cultivation of the crop. But given the possibility of market transactions, a situation in which damage to crops exceeded the rent of the land would not endure. Whether the cattle-raiser pays the farmer to leave the land uncultivated or himself rents the land by paying the land-owner an

amount slightly greater than the farmer would pay (if the farmer was himself renting the land), the final result would be the same and would maximise the value of production. Even when the farmer is induced to plant crops which it would not be profitable to cultivate for sale on the market, this will be a purely short-term phenomenon and may be expected to lead to an agreement under which the planting will cease. The cattle-raiser will remain in that location and the marginal cost of meat production will be the same as before, thus having no long-run effect on the allocation of resources.

IV. THE PRICING SYSTEM WITH NO LIABILITY FOR DAMAGE

I now turn to the case in which, although the pricing system is assumed to work smoothly (that is, costlessly), the damaging business is not liable for any of the damage which it causes. This business does not have to make a payment to those damaged by its actions. I propose to show that the allocation of resources will be the same in this case as it was when the damaging business was liable for damage caused. As I showed in the previous case that the allocation of resources was optimal, it will not be necessary to repeat this part of the argument.

I return to the case of the farmer and the cattle-raiser. The farmer would suffer increased damage to his crop as the size of the herd increased. Suppose that the size of the cattle-raiser's herd is 3 steers (and that this is the size of the herd that would be maintained if crop damage was not taken into account). Then the farmer would be willing to pay up to \$3 if the cattle-raiser would reduce his herd to 2 steers, up to \$5 if the herd were reduced to 1 steer and would pay up to \$6 if cattle-raising was abandoned. The cattle-raiser would therefore receive 53 from the farmer if he kept 2 steers instead of 3. This \$3 foregone is therefore part of the cost incurred in keeping the third steer. Whether the \$3 is a payment which the cattle-raiser has to make if he adds the third steer to his herd (which it would be if the cattle-raiser was liable to the farmer for damage caused to the crop) or whether it is a sum of money which he would have received if he did not keep a third steer (which it would be if the cattle-raiser was not liable to the farmer for damage caused to the crop) does not affect the final result. In both cases \$3 is part of the cost of adding a third steer, to be included along with the other costs. If the increase in the value of production in cattle-raising through increasing the size of the herd from 2 to 3 is greater than the additional costs that have to be incurred (including the \$3 damage to crops), the size of the herd will be increased. Otherwise, it will not. The size of the herd will be the same whether the cattle-raiser is liable for damage caused to the crop or not.

It may be argued that the assumed starting point—a herd of 3 steers—was arbitrary. And this is true. But the farmer would not wish to pay to avoid crop damage which the cattle-raiser would not be able to cause. For example, the maximum annual payment which the farmer could be induced to pay could not

exceed $9. the annual cost of fencing. And the farmer would only be willing to pay this sum if it did not reduce his earnings to a level that would cause him to abandon cultivation of this particular tract of land. Furthermore, the farmer would only be willing to pay this amount if he believed that, in the absence of any payment by him, the size of the herd maintained by the cattle-raiser would be 4 or more steers. Let us assume that this is the case. Then the farmer would be willing to pay up to $3 if the cattle-raiser would reduce his herd to 3 steers, up to $6 if the herd were reduced to 2 steers, up to $8 if one steer only were kept and up to $9 if cattle-raising were abandoned. It will be noticed that the change in the starting point has not altered the amount which would accrue to the cattle-raiser if he reduced the size of his herd by any given amount. It is still true that the cattle-raiser could receive an additional $3 from the farmer if he agreed to reduce his herd from 3 steers to 2 and that the $3 represents the value of the crop that would be destroyed by adding the third steer to the herd. Although a different belief on the part of the farmer (whether justified or not) about the size of the herd that the cattle-raiser would maintain in the absence of payments from him may affect the total payment he can be induced to pay, it is not true that this different belief would have any effect on the size of the herd that the cattle-raiser will actually keep. This will be the same as it would be if the cattle-raiser had to pay for damage caused by his cattle, since a receipt foregone of a given amount is the equivalent of a payment of the same amount.

It might be thought that it would pay the cattle-raiser to increase his herd above the size that he would wish to maintain once a bargain had been made, in order to induce the farmer to make a larger total payment. And this may be true. It is similar in nature to the action of the farmer (when the cattle-raiser was liable for damage) in cultivating land on which, as a result of an agreement with the cattle-raiser, planting would subsequently be abandoned (including land which would not be cultivated at all in the absence of cattle-raising). But such manoeuvres are preliminaries to an agreement and do not affect the long-run equilibrium position, which is the same whether or not the cattle-raiser is held responsible for the crop damage brought about by his cattle.

It is necessary to know whether the damaging business is liable or not for damage caused since without the establishment of this initial delimitation of rights there can be no market transactions to transfer and recombine them. But the ultimate result (which maximises the value of production) is independent of the legal position if the pricing system is assumed to work without cost.

V. THE PROBLEM ILLUSTRATED ANEW

The harmful effects of the activities of a business can assume a wide variety of forms. An early English case concerned a building which, by obstructing currents of air, hindered the operation of a windmill. A recent case in Florida

concerned a building which cast a shadow on the cabana, swimming pool and sunbathing areas of a neighbouring hotel. The problem of straying cattle and the damaging of crops which was the subject of detailed examination in the two preceding sections, although it may have appeared to be rather a special case, is in fact but one example of a problem which arises in many different guises. To clarify the nature of my argument and to demonstrate its general applicability, I propose to illustrate it anew by reference to four actual cases.

Let us first reconsider the case of *Sturges v. Bridgman* which I used as an illustration of the general problem In my article on "The Federal Communications Commission." In this case, a confectioner (in Wigmore Street) used two mortars and pestles in connection with his business (one had been in operation in the same position for more than 60 years and the other for more than 26 years). A doctor then came to occupy neighbouring premises (in Wimpole Street). The confectioner's machinery caused the doctor no harm until, eight years after he had first occupied the premises, he built a consulting room at the end of his garden right against the confectioner's kitchen. It was then found that the noise and vibration caused by the confectioner's machinery made it difficult for the doctor to use his new consulting room. "In particular ... the noise prevented him from examining his patients by auscultation for diseases of the chest. He also found it impossible to engage with effect in any occupation which required thought and attention." The doctor therefore brought a legal action to force the confectioner to stop using his machinery. The courts had little difficulty in granting the doctor the injunction he sought. "Individual cases of hardship may occur in the strict carrying out of the principle upon which we found our judgment, but the negation of the principle would lead even more to individual hardship, and would at the same time produce a prejudicial effect upon the development of land for residential purposes."

The court's decision established that the doctor had the right to prevent the confectioner from using his machinery. But, of course, it would have been possible to modify the arrangements envisaged in the legal ruling by means of a bargain between the parties. The doctor would have been willing to waive his right and allow the machinery to continue in operation if the confectioner would have paid him a sum of money which was greater than the loss of income which he would suffer from having to move to a more costly or less convenient location or from having to curtail his activities at this location or, as was suggested as a possibility, from having to build a separate wall which would deaden the noise and vibration. The confectioner would have been willing to do this if the amount he would have to pay the doctor was less than the fall in income he would suffer if he had to change his mode of operation at this location, abandon his operation or move his confectionery business to some other location. The solution of the problem depends essentially on whether the continued use of the machinery adds more to the confectioner's income than it subtracts from

the doctor's. But now consider the situation if the confectioner had won the case. The confectioner would then have had the right to continue operating his noise and vibration-generating machinery without having to pay anything to the doctor. The boot would have been on the other foot: the doctor would have had to pay the confectioner to induce him to stop using the machinery. If the doctor's income would have fallen more through continuance of the use of this machinery than it added to the income of the confectioner, there would clearly be room for a bargain whereby the doctor paid the confectioner to stop using the machinery. That is to say, the circumstances in which it would not pay the confectioner to continue to use the machinery and to compensate the doctor for the losses that this would bring (if the doctor had the right to prevent the confectioner's using his machinery) would be those in which it would be in the interest of the doctor to make a payment to the confectioner which would induce him to discontinue the use of the machinery (if the confectioner had the right to operate the machinery). The basic conditions are exactly the same in this case as they were in the example of the cattle which destroyed crops. With costless market transactions, the decision of the courts concerning liability for damage would be without effect on the allocation of resources. It was of course the view of the judges that they were affecting the working of the economic system-and in a desirable direction. Any other decision would have had "a prejudicial effect upon the development of land for residential purposes," an argument which was elaborated by examining the example of a forge operating on a barren moor. which was later developed for residential purposes. The judges' view that they were settling how the land was to be used would be true only in the case in which the costs of carrying out the necessary market transactions exceeded the gain which might be achieved by any rearrangement of rights. And it would be desirable to preserve the areas (Wimpole Street or the moor) for residential or professional use (by giving non-industrial users the right to stop the noise, vibration, smoke, etc., by injunction) only if the value of the additional residential facilities obtained was greater than the value of cakes or iron lost. But of this the judges seem to have been unaware.

The reasoning employed by the courts in determining legal rights will often seem strange to an economist because many of the factors on which the decision turns are, to an economist, irrelevant. Because of this, situations which are, from an economic point of view, identical will be treated quite differently by the courts. The economic problem in all cases of harmful effects is how to maximise the value of production. In the case of *Bass v. Gregory* fresh air was drawn in through the well which facilitated the production of beer but foul air was expelled through the well which made life in the adjoining houses less pleasant. The economic problem was to decide which to choose: a lower cost of beer and worsened amenities in adjoining houses or a higher cost of beer and improved amenities. In deciding this question, the "doctrine of lost grant" is

about as relevant as the colour of the judge's eyes. But it has to be remembered that the immediate question faced by the courts is not what shall be done by whom but who has the legal right to do what. It is always possible to modify by transactions on the market the initial legal delimitation of rights. And, of course, if such market transactions are costless, such a rearrangement of rights will always take place if it would lead to an increase in the value of production.

VI. THE COST OF MARKET TRANSACTIONS TAKEN INTO ACCOUNT

The argument has proceeded up to this point on the assumption (explicit in Sections III and IV and tacit in Section V) that there were no costs involved in carrying out market transactions. This is, of course, a very unrealistic assumption. In order to carry out a market transaction it is necessary to discover who it is that one wishes to deal with, to inform people that one wishes to deal and on what terms, to conduct negotiations leading up to a bargain, to draw up the contract, to undertake the inspection needed to make sure that the terms of the contract are being observed and so on. These operations are often extremely costly, sufficiently costly at any rate to prevent many transactions that would be carried out in a world in which the pricing system worked without cost.

In earlier sections, when dealing with the problem of the rearrangement of legal rights through the market, it was argued that such a rearrangement would be made through the market whenever this would lead to an increase in the value of production. But this assumed costless market transactions. Once the costs of carrying out market transactions are taken into account it is clear that such a rearrangement of rights will only be undertaken when the increase in the value of production consequent upon the rearrangement is greater than the costs which would be involved in bringing it about. When it is less, the granting of an injunction (or the knowledge that it would be granted) or the liability to pay damages may result in an activity being discontinued (or may prevent its being started) which would be undertaken if market transactions were costless. In these conditions the initial delimitation of legal rights does have an effect on the efficiency with which the economic system operates. One arrangement of rights may bring about a greater value of production than any other. But unless this is the arrangement of rights established by the legal system, the costs of reaching the same result by altering and combining rights through the market may be so great that this optimal arrangement of rights, and the greater value of production which it would bring, may never be achieved. The part played by economic considerations in the process of delimiting legal rights will be discussed in the next section. In this section, I will take the initial delimitation of rights and the costs of carrying out market transactions as given.

It is clear that an alternative form of economic organisation which could achieve the same result at less cost than would be incurred by using the market

would enable the value of production to be raised. As I explained many years ago, the firm represents such an alternative to organising production through market transactions. Within the firm individual bargains between the various cooperating factors of production are eliminated and for a market transaction is substituted an administrative decision. The rearrangement of production then takes place without the need for bargains between the owners of the factors of production. A landowner who has control of a large tract of land may devote his land to various uses taking into account the effect that the interrelations of the various activities will have on the net return of the land, thus rendering unnecessary bargains between those undertaking the various activities. Owners of a large building or of several adjoining properties in a given area may act in much the same way. In effect, using our earlier terminology, the firm would acquire the legal rights of all the parties and the rearrangement of activities would not follow on a rearrangement of rights by contract, but as a result of an administrative decision as to how the rights should be used.

It does not, of course, follow that the administrative costs of organising a transaction through a firm are inevitably less than the costs of the market transactions which are superseded. But where contracts are peculiarly difficult to draw up and an attempt to describe what the parties have agreed to do or not to do (e.g. the amount and kind of a smell or noise that they may make or will not make) would necessitate a lengthy and highly involved document, and, where, as is probable, a long-term contract would be desirable, it would be hardly surprising if the emergence of a firm or the extension of the activities of an existing firm was not the solution adopted on many occasions to deal with the problem of harmful effects. This solution would be adopted whenever the administrative costs of the firm were less than the costs of the market transactions that it supersedes and the gains which would result from the rearrangement of activities greater than the firm's costs of organising them. I do not need to examine in great detail the character of this solution since I have explained what is involved in my earlier article.

But the firm is not the only possible answer to this problem. The administrative costs of organising transactions within the firm may also be high, and particularly so when many diverse activities are brought within the control of a single organisation. In the standard case of a smoke nuisance, which may affect a vast number of people engaged in a wide variety of activities, the administrative costs might well be so high as to make any attempt to deal with the problem within the confines of a single firm impossible. An alternative solution is direct government regulation. Instead of instituting a legal system of rights which can be modified by transactions on the market, the government may impose regulations which state what people must or must not do and which have to be obeyed. Thus, the government (by statute or perhaps more likely through an administrative agency) may, to deal with the problem of smoke nuisance,

decree that certain methods of production should or should not be used (e.g. that smoke preventing devices should be installed or that coal or oil should not be burned) or may confine certain types of business to certain districts (zoning regulations).

The government is, in a sense, a superfirm (but of a very special kind) since it is able to influence the use of factors of production by administrative decision. But the ordinary firm is subject to cheeks in its operations because of the competition of other firms, which might administer the same activities at lower cost and also because there is always the alternative of market transactions as against organisation within the firm if the administrative costs become too great. The government is able, if it wishes, to avoid the market altogether, which a firm can never do. The firm has to make market agreements with the owners of the factors of production that it uses. Just as the government can conscript or seize property, so it can decree that factors of production should only be used in such-and-such a way. Such authoritarian methods save a lot of trouble (for those doing the organising). Furthermore, the government has at its disposal the police and the other law enforcement agencies to make sure that its regulations are carried out.

It is clear that the government has powers which might enable it to get some things done at a lower cost than could a private organisation (or at any rate one without special governmental powers). But the governmental administrative machine is not itself costless. It can, in fact, on occasion be extremely costly. Furthermore, there is no reason to suppose that the restrictive and zoning regulations, made by a fallible administration subject to political pressures and operating without any competitive check, will necessarily always be those which increase the efficiency with which the economic system operates. Furthermore, such general regulations which must apply to a wide variety of cases will be enforced in some cases in which they are clearly inappropriate. From these considerations it follows that direct governmental regulation will not necessarily give better results than leaving the problem to be solved by the market or the firm. But equally there is no reason why, on occasion, such governmental administrative regulation should not lead to an improvement in economic efficiency. This would seem particularly likely when, as is normally the case with the smoke nuisance, a large number of people are involved and in which therefore the costs of handling the problem through the market or the firm may be high.

There is, of course, a further alternative which is to do nothing about the problem at all. And given that the costs involved in solving the problem by regulations issued by the governmental administrative machine will often be heavy (particularly if the costs are interpreted to include all the consequences which follow from the government engaging in this kind of activity), it will no doubt be commonly the case that the gain which would come from regulating

the actions which give rise to the harmful effects will be less than the costs involved in government regulation.

The discussion of the problem of harmful effects in this section (when the costs of market transactions are taken into account) is extremely inadequate. But at least it has made clear that the problem is one of choosing the appropriate social arrangement for dealing with the harmful effects. All solutions have costs and there is no reason to suppose that government regulation is called for simply because the problem is not well handled by the market or the firm. Satisfactory views on policy can only come from a patient study of how, in practice, the market, firms and governments handle the problem of harmful effects. Economists need to study the work of the broker in bringing parties together, the effectiveness of restrictive covenants, the problems of the large-scale real-estate development company, the operation of government zoning and other regulating activities. It is my belief that economists, and policy-makers generally, have tended to over-estimate the advantages which come from governmental regulation. But this belief, even if justified, does not do more than suggest that government regulation should be curtailed. It does not tell us where the boundary line should be drawn. This, it seems to me, has to come from a detailed investigation of the actual results of handling the problem in different ways. But it would be unfortunate if this investigation were undertaken with the aid of a faulty economic analysis. The aim of this article is to indicate what the economic approach to the problem should be.

VII. THE LEGAL DELIMITATION OF RIGHTS AND THE ECONOMIC PROBLEM

The discussion in Section V not only served to illustrate the argument but also afforded a glimpse at the legal approach to the problem of harmful effects. The cases considered were all English but a similar selection of American cases could easily be made and the character of the reasoning would have been the same. Of course, if market transactions were costless, all that matters (questions of equity apart) is that the rights of the various parties should be well-defined and the results of legal actions easy to forecast. But as we have seen, the situation is quite different when market transactions are so costly as to make it difficult to change the arrangement of rights established by the law. In such cases, the courts directly influence economic activity. It would therefore seem desirable that the courts should understand the economic consequences of their decisions and should, insofar as this is possible without creating too much uncertainty about the legal position itself, take these consequences into account when making their decisions. Even when it is possible to change the legal delimitation of rights through market transactions, it is obviously desirable to reduce the need for such transactions and thus reduce the employment of resources in carrying them out.

A thorough examination of the presuppositions of the courts in trying such cases would be of great interest but I have not been able to attempt it. Nevertheless it is clear from a cursory study that the courts have often recognized the economic implications of their decisions and are aware (as many economists are not) of the reciprocal nature of the problem. Furthermore, from time to time, they take these economic implications into account, along with other factors, in arriving at their decisions. The American writers on this subject refer to the question in a more explicit fashion than do the British. Thus, to quote Prosser on Torts, a person may

> make use of his own property or ... conduct his own affairs at the expense of some harm to his neighbours. He may operate a factory whose noise and smoke cause some discomfort to others, so long as he keeps within reasonable bounds. It is only when his conduct is unreasonable,*in the light of its utilitliy and the harm which results* [italics added], that it becomes a nuisance .... As it was said in an ancient case in regard to candle-making in a town,"Le utility del chose excusera le noisomeness del stink."
>
> The world must have factories, smelters, oil refineries, noisy machinery and blasting, even at the expense of some inconvenience to those in the vicinity and the plaintiff may be required to accept some not unreasonable discomfort for the general good.

The standard British writers do not state as explicitly as this that a comparison between the utility and harm produced is an element in deciding whether a harmful effect should be considered a nuisance. But similar views, if less strongly expressed, are to be found. The doctrine that the harmful effect must be substantial before the court will act is, no doubt, in part a reflection of the fact that there will almost always be some gain to offset the harm. And in the reports of individual cases, it is clear that the judges have had in mind what would be lost as well as what would be gained in deciding whether to grant an injunction or award damages. Thus, in refusing to prevent the destruction of a prospect by a new building, the judge stated:

> I know no general rule of common law, which ... says, that building so as to stop another's prospect is a nuisance. Was that the case, there could be no great towns; and I must grant injunctions to all the new buildings in this town ...

The problem which we face in dealing with actions which have harmful effects is not simply one of restraining those responsible for them. What has to be decided is whether the gain from preventing the harm is greater than the loss which would be suffered elsewhere as a result of stopping the action which produces the harm. In a world in which there are costs of rearranging the rights established by the legal system, the courts, in cases relating to nuisance,

are, in effect, making a decision on the economic problem and determining how resources are to be employed. It was argued that the courts are conscious of this and that they often make, although not always in a very explicit fashion, a comparison between what would be gained and what lost by preventing actions which have harmful effects. But the delimitation of rights is also the result of statutory enactments. Here we also find evidence of an appreciation of the reciprocal nature of the problem. While statutory enactments add to the list of nuisances, action is also taken to legalize what would otherwise be nuisances under the common law. The kind of situation which economists are prone to consider as requiring corrective government action is, in fact, often the result of government action. Such action is not necessarily unwise. But there is a real danger that extensive government intervention in the economic system may lead to the protection of those responsible for harmful effects being carried too far.

VIII. PIGOU'S TREATMENT IN "THE ECONOMICS OF WELFARE"

The fountainhead for the modern economic analysis of the problem discussed in this article is Pigou's *Economics of Welfare* and, in particular, that section of Part II which deals with divergences between social and private net products which come about because

> one person A, in the course of rendering some service, for which payment is made, to a second person B, incidentally also renders services or disservices to other persons (not producers of like services), or such a sort that payment cannot be exacted from the benefited parties or compensation enforced on behalf of the injured parties.

Pigou tells us that his aim in Part II of *The Economics of Welfare* is

> to ascertain how far the free play of self-interest, acting under the existing legal system, tends to distribute the country's resources in the way most favorable to the production of a large national dividend, and how far it is feasible for State action to improve upon 'natural' tendencies.

To judge from the first part of this statement, Pigou's purpose is to discover whether any improvements could be made in the existing arrangements which determine the use of resources. Since Pigou's conclusion is that improvements could be made, one might have expected him to continue by saying that he proposed to set out the changes required to bring them about. Instead, Pigou adds a phrase which contrasts "natural" tendencies with State action, which seems in some sense to equate the present arrangements with -natural- tendencies and to imply that what is required to bring about these improvements is State action (if feasible). That this is more or less Pigou's position is

evident from Chapter 1 of Part II. Pigou starts by referring to -optimistic followers of the classical economists who have argued that the value of production would be maximised if the government refrained from any interference in the economic system and the economic arrangements were those which came about "naturally." Pigou goes on to say that if self-interest does promote economic welfare, it is because human institutions have been devised to make it so. (This part of Pigou's argument, which he develops with the aid of a quotation from Carman, seems to me to be essentially correct.) Pigou concludes:

> But even in the most advanced States there are failures and imperfections .... there are many obstacles that prevent a community's resources from being distributed ... in the most efficient way. The study of these constitutes our present problem .... its purpose is essentially practical. It seeks to bring into clearer light some of the ways in which it now is, or eventually may become, feasible for governments to control the play of economic forces in such wise as to promote the economic welfare, and through that, the total welfare, of their citizens as a whole.

Pigou's underlying thought would appear to be: Some have argued that no State action is needed. But the system has performed as well as it has because of State action. Nonetheless, there are still imperfections. What additional State action is required?

If this is a correct summary of Pigou's position, its inadequacy can be demonstrated by examining the first example he gives of a divergence between private and social products.

> It might happen that costs are thrown upon people not directly concerned, through, say, uncompensated damage done to surrounding woods by sparks from railway engines. All such effects must be included-some of them will be positive, others negative elements-in reckoning up the social net product of the marginal increment of any volume of resources turned into any use or place.

The example used by Pigou refers to a real situation. In Britain, a railway does not normally have to compensate those who suffer damage by fire caused by sparks from an engine. Taken in conjunction with what he says in Chapter 9 of Part II, I take Pigou's policy recommendations to be, first, that there should be State action to correct this "natural" situation and, second, that the railways should be forced to compensate those whose woods are burnt. If this is a correct interpretation of Pigou's position, I would argue that the first recommendation is based on a misapprehension of the facts and that the second is not necessarily desirable.

Let us consider the legal position. Under the heading "Sparks from engines," we find the following in Halsbury's *Laws of England:*

> If railway undertakers use steam engines on their railway without express statutory authority to do so, they are liable, irrespective of any negligence on their part, for fires caused by sparks from engines. Railway undertakers are, however, generally given statutory authority to use steam engines on their railway; accordingly, if an engine is constructed with the precautions which science suggests against fire and is used without negligence, they are not responsible at common law for any damage which may be done by sparks .... In the construction of an engine the undertaker is bound to use all the discoveries which science has put within its reach in order to avoid doing harm, provided they are such as it is reasonable to require the company to adopt, having proper regard to the likelihood of the damage and to the cost and convenience of the remedy; but it is not negligence on the part of an undertaker if it refuses to use an apparatus the efficiency of which is open to bona fide doubt.

To this general rule, there is a statutory exception arising from the Railway (Fires) Act, 1905, as amended in 1923. This concerns agricultural land or agricultural crops.

> In such a case the fact that the engine was used under statutory powers does not affect the liability of the company in an action for the damage .... These provisions, however, only apply where the claim for damage ... does not exceed £200 [£100 in the 1905 Act], and where written notice of the occurrence of the fire and the intention to claim has been sent to the company within seven days of the occurrence of the damage and particulars of the damage in writing showing the amount of the claim in money not exceeding £200 have been sent to the company within twenty-one days.

Agricultural land does not include moorland or buildings and agricultural crops do not include those led away or stacked. I have not made a close study of the parliamentary history of this statutory exception, but to judge from debates in the House of Commons in 1922 and 1923, this exception was probably designed to help the smallholder.

Let us return to Pigou's example of uncompensated damage to surrounding woods caused by sparks from railway engines. This is presumably intended to show how it is possible "for State action to improve on 'natural' tendencies." If we treat Pigou's example as referring to the position before 1905, or as being an arbitrary example (in that he might just as well have written "surrounding buildings" instead of "surrounding woods"), then it is clear that the reason why compensation was not paid must have been that the railway had statutory authority to run steam engines (which relieved it of liability for fires caused by sparks). That this was the legal position was established in 1860, in a case,

oddly enough, which concerned the burning of surrounding woods by a railway, and the law on this point has not been changed (apart from the one exception) by a century of railway legislation, including nationalisation. If we treat Pigou's example of "uncompensated damage done to surrounding woods by sparks from railway engines" literally, and assume that it refers to the period after 1905, then it is clear that the reason why compensation was not paid must have been that the damage was more than £100 (in the first edition of *The Economics of Welfare*) or more than £200 (in later editions) or that the owner of the wood failed to notify the railway in writing within seven days of the fire or did not send particulars of the damage, in writing, within twenty-one days. In the real world, Pigou's example could only exist as a result of a deliberate choice of the legislature. It is not, of course, easy to imagine the construction of a railway in a state of nature. The nearest one can get to this is presumably a railway which uses steam engines "without express statutory authority." However, in this case the railway would be obliged to compensate those whose woods it burnt down. That is to say, compensation would be paid in the absence of Government action. The only circumstances in which compensation would not be paid would be those in which there had been Government action. It is strange that Pigou, who clearly thought it desirable that compensation should be paid, should have chosen this particular example to demonstrate how it is possible "for State action to improve on 'natural' tendencies."

Pigou seems to have had a faulty view of the facts of the situation. But it also seems likely that he was mistaken in his economic analysis. It is not necessarily desirable that the railway should be required to compensate those who suffer damage by fires caused by railway engines. I need not show here that, if the railway could make a bargain with everyone having property adjoining the railway line and there were no costs involved in making such bargains, it would not matter whether the railway was liable for damage caused by fires or not. This question has been treated at length in earlier sections. The problem is whether it would be desirable to make the railway liable in conditions in which it is too expensive for such bargains to be made. Pigou clearly thought it was desirable to force the railway to pay compensation and it is easy to see the kind of argument that would have led him to this conclusion. Suppose a railway is considering whether to run an additional train or to increase the speed of an existing train or to install spark-preventing devices on its engines. If the railway were not liable for fire damage, then, when making these decisions, it would not take into account as a cost the increase in damage resulting from the additional train or the faster train or the failure to install sparkpreventing devices. This is the source of the divergence between private and social net products. It results in the railway performing acts which will lower the value of total production-and which it would not do if it were liable for the damage. This can be shown by means of an arithmetical example.

Consider a railway, which is not liable for damage by fires caused by sparks from its engines, which runs two trains per day on a certain line. Suppose that running one train per day would enable the railway to perform services worth $150 per annum and running two trains a day would enable the railway to perform services worth $250 per annum. Suppose further that the cost of running one train is $50 per annum and two trains $ 100 per annum. Assuming perfect competition, the cost equals the fall in the value of production elsewhere due to the employment of additional factors of production by the railway. Clearly the railway would find it profitable to run two trains per day. But suppose that running one train per day would destroy by fire crops worth (on an average over the year) $60 and two trains a day would result in the destruction of crops worth $120. In these circumstances running one train per day would raise the value of total production but the running of a second train would reduce the value of total production. The second train would enable additional railway services worth $100 per annurn to be performed. But the fall in the value of production elsewhere would be $110 per annum; $50 as a result of the employment of additional factors of production and $60 as a result of the destruction of crops. Since it would be better if the second train were not run and since it would not run if the railway were liable for damage caused to crops, the conclusion that the railway should be made liable for the damage seems irresistible. Undoubtedly it is this kind of reasoning which underlies the Pigovian position.

The conclusion that it would be better if the second train did not run is correct. The conclusion that it is desirable that the railway should be made liable for the damage it causes is wrong. Let us change our assumption concerning the rule of liability. Suppose that the railway is liable for damage from fires caused by sparks from the engine. A farmer on lands adjoining the railway is then in the position that. if his crop is destroyed by fires caused by the railway, he will receive the market price from the railway: but if his crop is not damaged, he will receive the market price by sale. It therefore becomes a matter of indifference to him whether his crop is damaged by fire or not. The position is very different when the railway is not liable. Any crop destruction through railway-caused fires would then reduce the receipts of the farmer. He would therefore take out of cultivation any land for which the damage is likely to be greater than the net return of the land (for reasons explained at length in Section III). A change from a regime in which the railway is not liable for damage to one in which it is liable is likely therefore to lead to an increase in the amount of cultivation on lands adjoining the railway. It will also, of course, lead to an increase in the amount of crop destruction due to railway-caused fires.

Let us return to our arithmetical example. Assume that, with the changed rule of liability, there is a doubling in the amount of crop destruction due to railway-caused fires. With one train per day, crops worth $120 would be

destroyed each year and two trains per day would lead to the destruction of crops worth $240. We saw previously that it would not be profitable to run the second train if the railway had to pay $60 per annum as compensation for damage. With damage at $120 per annum the loss from running the second train would be $60 greater. But now let us consider the first train. The value of the transport services furnished by the first train is $150. The cost of running the train is $50. The amount that the railway would have to pay out as compensation for damage is $120. If follows that it would not be profitable to run any trains. With the figures in our example we reach the following result: if the railway is not liable for fire-damage, two trains per day would be run; if the railway is liable for fire-damage, it would cease operations altogether. Does this mean that it is better that there should be no railway? This question can be resolved by considering what would happen to the value of total production if it were decided to exempt the railway from liability for fire-damage, thus bringing it into operation (with two trains per day).

The operation of the railway would enable transport services worth $250 to be performed. It would also mean the employment of factors of production which would reduce the value of production elsewhere by $100. Furthermore it would mean the destruction of crops worth $120. The coming of the railway will also have led to the abandonment of cultivation of some land. Since we know that, had this land been cultivated, the value of the crops destroyed by fire would have been $120, and since it is unlikely that the total crop on this land would have been destroyed, it seems reasonable to suppose that the value of the crop yield on this land would have been higher than this. Assume it would have been $160. But the abandonment of cultivation would have released factors of production for employment elsewhere. All we know is that the amount by which the value of production elsewhere will increase will be less than $160. Suppose that it is $150. Then the gain from operating the railway would be $250 (the value of the transport services) minus $100 (the cost of the factors of production) minus $120 (the value of crops destroyed by fire) minus $160 (the fall in the value of crop production due to the abandonment of cultivation) plus $150 (the value of production elsewhere of the released factors of production). Overall, operating the railway will increase the value of total production by $20. With these figures it is clear that it is better that the railway should not be liable for the damage it causes, thus enabling it to operate profitably. Of course, by altering the figures, it could be shown that there are other cases in which it would be desirable that the railway should be liable for the damage it causes. It is enough for my purpose to show that, from an economic point of view, a situation in which there is "uncompensated damage done to surrounding woods by sparks from railway engines" is not necessarily undesirable. Whether it is desirable or not depends on the particular circumstances.

How is it that the Pigovian analysis seems to give the wrong answer?

The reason is that Pigou does not seem to have noticed that his analysis is dealing with an entirely different question. The analysis as such is correct. But it is quite illegitimate for Pigou to draw the particular conclusion he does. The question at issue is not whether it is desirable to run an additional train or a faster train or to install smoke-preventing devices; the question at issue is whether it is desirable to have a system in which the railway has to compensate those who suffer damage from the fires which it causes or one in which the railway does not have to compensate them. When an economist is comparing alternative social arrangements, the proper procedure is to compare the total social product yielded by these different arrangements. The comparison of private and social products is neither here nor there. A simple example will demonstrate this. Imagine a town in which there are traffic lights. A motorist approaches an intersection and stops because the light is red. There are no cars approaching the intersection on the other street. If the motorist ignored the red signal, no accident would occur and the total product would increase because the motorist would arrive earlier at his destination. Why does he not do this? The reason is that if he ignored the light he would be fined. The private product from crossing the street is less than the social product. Should we conclude from this that the total product would be greater if there were no fines for failing to obey traffic signals? The Pigovian analysis shows us that it is possible to conceive of better worlds than the one in which we live. But the problem is to devise practical arrangements which will correct defects in one part of the system without causing more serious harm in other parts.

I have examined in considerable detail one example of a divergence between private and social products and I do not propose to make any further examination of Pigou's analytical system. But the main discussion of the problem considered in this article is to be found in that part of Chapter 9 in Part II which deals with Pigou's second class of divergence and it is of interest to see how Pigou develops his argument. Pigou's own description of this second class of divergence was quoted at the beginning of this section. Pigou distinguishes between the case in which a person renders services for which he receives no payment and the case in which a person renders disservices and compensation is not given to the injured parties. Our main attention has, of course, centred on this second case. It is therefore rather astonishing to find, as was pointed out to me by Professor Francesco Forte, that the problem of the smoking chimney—the "stock instance" or "classroom example" of the second case—is used by Pigou as an example of the first case (services rendered without payment) and is never mentioned, at any rate explicitly, in connection with the second case. Pigou points out that factory owners who devote resources to preventing their chimneys from smoking render services for which they receive no payment. The implication, in the light of Pigou's discussion later in the chapter, is that a factory owner with a smokey chimney should be given a bounty to induce him

to install smoke-preventing devices. Most modern economists would suggest that the owner of the factory with the smokey chimney should be taxed. It seems a pity that economists (apart from Professor Forte) do not seem to have noticed this feature of Pigou's treatment since a realisation that the problem could be tackled in either of these two ways would probably have led to an explicit recognition of its reciprocal nature.

In discussing the second case (disservices without compensation to those damaged), Pigou says that they are rendered "when the owner of a site in a residential quarter of a city builds a factory there and so destroys a great part of the amenities of neighbouring sites; or, in a less degree, when he uses his site in such a way as to spoil the lighting of the house opposite; or when he invests resources in erecting buildings in a crowded centre, which by contracting the air-space and the playing room of the neighbourhood, tend to injure the health and efficiency of the families living there." Pigou is, of course, quite right to describe such actions as "uncharged disservices." But he is wrong when he describes these actions as "anti-social." They may or may not be. It is necessary to weigh the harm against the good that will result. Nothing could be more "anti-social" than to oppose any action which causes any harm to anyone.

Indeed, Pigou's treatment of the problems considered in this article is extremely elusive and the discussion of his views raises almost insuperable difficulties of interpretation. Consequently it is impossible to be sure that one has understood what Pigou really meant. Nevertheless, it is difficult to resist the conclusion, extraordinary though this may be in an economist of Pigou's stature, that the main source of this obscurity is that Pigou had not thought his position through.

IX. THE PIGOVIAN TRADITION

It is strange that a doctrine as faulty as that developed by Pigou should have been so influential, although part of its success has probably been due to the lack of clarity in the exposition. Not being clear, it was never clearly wrong. Curiously enough, this obscurity in the source has not prevented the emergence of a fairly well-defined oral tradition. What economists think they learn from Pigou, and what they tell their students, which I term the Pigovian tradition, is reasonably clear. I propose to show the inadequacy of this Pigovian tradition by demonstrating that both the analysis and the policy conclusions which it supports are incorrect.

I do not propose to justify my view as to the prevailing opinion by copious references to the literature. I do this partly because the treatment in the literature is usually so fragmentary, often involving little more than a reference to Pigou plus some explanatory comment, that detailed examination would be inappropriate. But the main reason for this lack of reference is that the

doctrine, although based on Pigou, must have been largely the product of an oral tradition. Certainly economists with whom I have discussed these problems have shown a unanimity of opinion which is quite remarkable considering the meagre treatment accorded this subject in the literature. No doubt there are some economists who do not share the usual view but they must represent a small minority of the profession.

The approach to the problems under discussion is through an examination of the value of physical production. The private product is the value of the additional product resulting from a particular activity of a business. The social product equals the private product minus the fall in the value of production elsewhere for which no compensation is paid by the business. Thus, if 10 units of a factor (and no other factors) are used by a business to make a certain product with a value of $105; and the owner of this factor is not compensated for their use, which he is unable to prevent; and these 10 units of the factor would yield products in their best alternative use worth $100; then, the social product is $105 minus $l00 or $5. If the business now pays for one unit of the factor and its price equals the value of its marginal product, then the social product rises to $15. If two units are paid for, the social product rises to $25 and so on until it reaches $105 when all units of the factor are paid for. It is not difficult to see why economists have so readily accepted this rather odd procedure. The analysis focusses on the individual business decision and since the use of certain resources is not allowed for in costs, receipts are reduced by the same amount. But, of course. this means that the value of the social product has no social significance whatsoever. It seems to me preferable to use the opportunity cost concept and to approach these problems by comparing the value of the product yielded by factors in alternative uses or by

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The definition of the social product is queer but this does not mean that the conclusions for policy drawn from the analysis are necessarily wrong. However, there are bound to be dangers in an approach which diverts attention from the basic issues and there can be little doubt that it has been responsible for some of the errors in current doctrine. The belief that it is desirable that the business which causes harmful effects should be forced to compensate those who suffer damage (which was exhaustively discussed in Section VIII in connection with Pigou's railway sparks example) is undoubtedly the result of not comparing the

total product obtainable with alternative social arrangements.

The same fault is to be found in proposals for solving the problem of harmful effects by the use of taxes or bounties. Pigou lays considerable stress on this solution although he is, as usual, lacking in detail and qualified in his support. Modern economists tend to think exclusively in terms of taxes and in a very precise way. The tax should be equal to the damage done and should therefore vary with the amount of the harmful effect. As it is not proposed that the proceeds of the tax should be paid to those suffering the damage, this solution is not the same as that which would force a business to pay compensation to those damaged by its actions, although economists generally do not seem to have noticed this and tend to treat the two solutions as being identical.

Assume that a factory which emits smoke is set up in a district previously free from smoke pollution, causing damage valued at $100 per annum. Assume that the taxation solution is adopted and that the factoryowner is taxed $100 per annum as long as the factory emits the smoke. Assume further that a smoke-preventing device costing $90 per annum to run is available. In these circumstances, the smoke-preventing device would be installed. Damage of $100 would have been avoided at an expenditure of $90 and the factory-owner would be better off by $10 per annum. Yet the position achieved may not he optimal. Suppose that those who suffer the damage could avoid it by moving to other locations or by taking various precautions which would cost them, or be equivalent to a loss in income of, $40 per annum. Then there would be a gain in the value of production of $50 if the factory continued to emit its smoke and those now in the district moved elsewhere or made other adjustments to avoid the damage. If the factory owner is to be made to pay a tax equal to the damage caused, it would clearly be desirable to institute a double tax system and to make residents of the district pay an amount equal to the additional cost incurred by the factory owner (or the consumers of his products) in order to avoid the damage. In these conditions, people would not stay in the district or would take other measures to prevent the damage from occurring, when the costs of doing so were less than the costs that would be incurred by the producer to reduce the damage (the producer's object, of course, being not so much to reduce the damage as to reduce the tax payments). A tax system which was confined to a tax on the producer for damage caused would tend to lead to unduly high costs being incurred for the prevention of damage. Of course this could be avoided if it were possible to base the tax, not on the damage caused, but on the fall in the value of production (in its widest sense) resulting from the emission of smoke. But to do so would require a detailed knowledge of individual preferences and I am unable to imagine how the data needed for such a taxation system could be assembled. Indeed, the proposal to solve the smoke pollution and similar problems by the use of taxes bristles

with difficulties: the problem of calculation, the difference between average and marginal damage, the interrelations between the damage suffered on different properties, etc. But it is unnecessary to examine these problems here. It is enough for my purpose to show that, even if the tax is exactly adjusted to equal the damage that would be done to neighbouring properties as a result of the emission of each additional puff of smoke, the tax would not necessarily bring about optimal conditions. An increase in the number of people living or of businesses operating in the vicinity of the smoke-emitting factory will increase the amount of harm produced by a given emission of smoke. The tax that would be imposed would therefore increase with an increase in the number of those in the vicinity. This will tend to lead to a decrease in the value of production of the factors employed by the factory, either because a reduction in production due to the tax will result in factors being used elsewhere in ways which are less valuable, or because factors will be diverted to produce means for reducing the amount of smoke emitted. But people deciding to establish themselves in the vicinity of the factory will not take into account this fall in the value of production which results from their presence. This failure to take into account costs imposed on others is comparable to the action of a factory owner in not taking into account the harm resulting from his emission of smoke. Without the tax, there may be too much smoke and too few people in the vicinity of the factory; but with the tax there may be too little smoke and too many people in the vicinity of the factory. There is no reason to suppose that one of these results is necessarily preferable.

I need not devote much space to discussing the similar error involved in the suggestion that smoke-producing factories should, by means of zoning regulations, be removed from the districts in which the smoke causes harmful effects. When the change in the location of the factory results in a reduction in production, this obviously needs to be taken into account and weighed against the harm which would result from the factory remaining in that location. The aim of such regulation should not be to eliminate smoke pollution but rather to secure the optimum amount of smoke pollution, this being the amount which will maximise the value of production.

X. A CHANGE OF APPROACH

It is my belief that the failure of economists to reach correct conclusions about the treatment of harmful effects cannot be ascribed simply to a few slips in analysis. It stems from basic defects in the current approach to problems of welfare economics. What is needed is a change of approach.

Analysis in terms of divergencies between private and social products concentrates attention on particular deficiencies in the system and tends to nourish the belief that any measure which will remove the deficiency is necessarily desirable. It diverts attention from those other changes in the system which are

inevitably associated with the corrective measure, changes which may well produce more harm than the original deficiency. In the preceding sections of this article, we have seen many examples of this. But it is not necessary to approach the problem in this way. Economists who study problems of the firm habitually use an opportunity cost approach and compare the receipts obtained from a given combination of factors with alternative business arrangements. It would seem desirable to use a similar approach when dealing with questions of economic policy and to compare the total product yielded by alternative social arrangements. In this article, the analysis has been confined, as is usual in this part of economics, to comparisons of the value of production, as measured by the market. But it is, of course, desirable that the choice between different social arrangements for the solution of economic problems should be carried out in broader terms than this and that the total effect of these arrangements in all spheres of life should be taken into account. As Frank H. Knight has so often emphasized, problems of welfare economics must ultimately dissolve into a study of aesthetics and morals.

A second feature of the usual treatment of the problems discussed in this article is that the analysis proceeds in terms of a comparison between a state of laissez faire and some kind of ideal world. This approach inevitably leads to a looseness of thought since the nature of the alternatives being compared is never clear. In a state of laissez faire. is there a monetary, a legal or a political system and if so, what are they? In an ideal world, would there be a monetary, a legal or a political system and if so, what would they be? The answers to all these questions are shrouded in mystery and every man is free to draw whatever conclusions he likes. Actually very little analysis is required to show that an ideal world is better than a state of laissez faire, unless the definitions of a state of laissez faire and an ideal world happen to be the same. But the whole discussion is largely irrelevant for questions of economic policy since whatever we may have in mind as our ideal world, it is clear that we have not yet discovered how to get to it from where we are. A better approach would seem to be to start our analysis with a situation approximating that which actually exists, to examine the effects of a proposed policy change and to attempt to decide whether the new situation would be, in total, better or worse than the original one. In this way, conclusions for policy would have some relevance to the actual situation.

A final reason for the failure to develop a theory adequate to handle the problem of harmful effects stems from a faulty concept of a factor of production. This is usually thought of as a physical entity which the businessman acquires and uses (an acre of land, a ton of fertiliser) instead of as a right to perform certain (physical) actions. We may speak of a person owning land and using it as a factor of production but what the land-owner in fact possesses is the right to carry out a circumscribed list of actions. The rights of a land-owner are not

unlimited. It is not even always possible for him to remove the land to another place, for instance, by quarrying it. And although it may be possible for him to exclude some people from using "his" land, this may not be true of others. For example, some people may have the right to cross the land. Furthermore, it may or may not be possible to erect certain types of buildings or to grow certain crops or to use particular drainage systems on the land. This does not come about simply because of Government regulation. It would be equally true under the common law. In fact it would be true under any system of law. A system in which the rights of individuals were unlimited would be one in which there were no rights to acquire.

If factors of production are thought of as rights, it becomes easier to understand that the right to do something which has a harmful effect (such as the creation of smoke, noise, smells, etc.) is also a factor of production. Just as we may use a piece of land in such a way as to prevent someone else from crossing it, or parking his car, or building his house upon it, so we may use it in such a way as to deny him a view or quiet or unpolluted air. The cost of exercising a right (of using a factor of production) is always the loss which is suffered elsewhere in consequence of the exercise of that right-the inability to cross land, to park a car, to build a house, to enjoy a view. to have peace and quiet or to breathe clean air.

It would clearly be desirable if the only actions performed were those in which what was gained was worth more than what was lost. But in choosing between social arrangements within the context of which individual decisions are made, we have to bear in mind that a change in the existing system which will lead to an improvement in some decisions may well lead to a worsening of others. Furthermore we have to take into account the costs involved in operating the various social arrangements (whether it be the working of a market or of a government department) as well as the costs involved in moving to a new system. In devising and choosing between social arrangements we should have regard for the total effect. This, above all, is the change in approach which I am advocating.