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RENT UNDER THE ASSUMPTION OF EXHAUSTIBILITY

SUMMARY

The abstract character of the conception of land as the basis of rent, 466. — Modification of the rent theory according to the possibility of preventing exhaustion, 469. — Effect of the assumption of exhaustion upon the economic intensity of utilization, 471. — Influence of the rate of interest on intensity of utilization, 474. — Influence of prices on intensity of utilization, 477. — Determination of the extensive margin, 480. — The so-called royalty from mines forms a part of economic rent; Ricardo's discussion, 481. — Relation of royalties and rents to prices, 485. — Incidence of taxation under the modified assumptions, 486. — Conclusion, 488.

IN the infancy of economic science rent was distinguished from other forms of income as the periodic return from the use of land. And because land itself was regarded as one of the great agents in production, the existence of a peculiar type of income attributable to it appeared particularly suitable.

This complete correlation between rent as an income and land as its source was not destined to continue. In the England of the classical school rent was usually a form of income which seemed to leave the basis of income unimpaired. Year after year the landowner might receive a substantial return without decreasing the capital value of his investment. It is not strange that the imperishability of the basis of rent came to be considered an essential characteristic of rent as a form of income. It became necessary, therefore, to define anew the basis of rent so that it might conform to this preconceived essential characteristic of rent itself. Accordingly Ricardo modified the economic concept of land as the source of a rent payment, and introduced the

assumption that rent is a payment for "the original and indestructible qualities of the soil." Later writers have interpreted Ricardo's criterion of land more rigorously than did Ricardo; and after passing through a process of gradual refinement, the Ricardian assumption has been reduced to its extreme form in Professor Commons' conclusion that the property of extension is the essential quality which distinguishes land from other kinds of goods and constitutes the basis of rent.¹ Thus the concept of land as the basis of rent has been gradually reduced to an abstraction.

A practical man might well ask why it is necessary to develop an elaborate and peculiar doctrine to explain the value of the services of natural agents when by very assumption a large part of natural agents are excluded from the scope of the explanation. Why must rent be a payment for an original and indestructible property in order to be rent? The question is a part of the long continued dispute as to the desirability of distinguishing land from capital, and rent from other forms of income. It is not necessary, however, in this connection, to wander so far afield. This question may be disregarded if it can be shown that indestructibility is not a characteristic which separates rent from other forms of income. The ground will then be clear for a reconsideration of the rent theory under the assumption of exhaustibility.

In one sense there is no basis of rent which is imperishable. For there is no conceivable basis which might not lose its utility, and therefore, its ability to yield a rent. A change in social demand may cause even the property of extension to lose the ability to yield a rent. However, it may be alleged with justice that the word *indestructible* has been employed by

¹ Professor Marshall seems inclined to a similar view, altho he has not come out unreservedly in its favor. Principles of Economics, 5th ed., bk. iv, chap. ii, sec. i.

Ricardo and his followers in quite another sense: in the sense that the use for which rent is paid does not cause the impairment of the basis of rent. In this sense the basis of rent may be indestructible. The clearest illustration is urban land. In the case of agricultural land also it is frequently possible to isolate the income attributable to the indestructible properties. When the elements which are exhausted are economically replaceable, the expense of replacement determines the value of the exhausted elements; and the remainder of the total surplus may be considered the rent of the inexhaustible properties. In many cases, however, it is not possible to isolate the returns assignable to the indestructible properties. In the case of mines, for instance, it is impossible to separate the value of the exhausted properties from the value of the inexhaustible properties. It is easy to determine how much the capital value of a coal mine is reduced by the process of use. But this capital value is nothing more than the present value of the surplus income from the mine during a period of time, — that is, the present value of the total rent which it will yield, — and this rent consists of two indistinguishable elements: the return for the coal used up and the return for the site value of that coal. A similar impossibility exists in the use of agricultural land when it is more profitable to exploit the soil than to conserve it: for instance, under frontier conditions.

It seems clear, then, that under the Ricardian assumption rent may be referred to a small part only of the total category of natural objects. Moreover it is frequently impossible to distinguish rent from the income of the destructible elements. These facts appear to justify an attempt to alter the Ricardian statement of rent in such a way as to avoid the necessity of assum-

ing that rent is paid only for the "indestructible qualities of the soil."

Exhaustion consists either in a change of place or in a change of form. Coal may be removed from a mine and continue undestroyed. In this case the exhaustion is merely relative to a given locality. So far as the theory of rent is concerned, it is the exhaustion with reference to a particular locality that is of primary importance whether the valuable elements are absolutely consumed or merely removed to another location.

This exhaustion with reference to location may be prevented by restoring other elements of the same kind in place of those removed in the process of utilization. Whether or not this is true depends to a large extent upon economic conditions. For instance, it is physically possible to restore a forest, but such a restoration may not pay. It is even physically possible to restore mineral that has been removed from a mine, but it is hardly conceivable that it would ever be economical. Even in the case of agriculture, the experience of the world has abundantly proven that restoration is frequently unprofitable. In this sense exhaustion may be characteristic, under certain conditions, of nearly all natural objects.

The relation of the assumption of exhaustion to the theory of rent largely depends upon the possibility of preventing exhaustion so far as a given locality is concerned. It is necessary, therefore, to consider several cases which may be presented schematically as follows:

1. Prevention of exhaustion is economical.
 - (a) May be effected without additional expense.
 - (b) Requires additional expense.
2. Prevention of exhaustion is not economical.

When prevention requires no extra expense, the Ricardian theory is not invalidated by the assumption of

exhaustion. The entire return attributable to land is a surplus which accrues so long as the conditions of demand and supply remain unchanged. Exhaustion occurs; but the process of restoration is merely incidental to the process of most profitable utilization. Likewise, the assumption that exhaustion is preventable, provided it is profitable to incur an extra expense for that purpose, does not seriously impair the Ricardian theory of rent. The extra expense either may be considered a part of the expense incident to the process of production or may be charged against the land and deducted from its net return. In both cases the rent, after all deductions are made, will be the same. The difference is merely one of accounting.

In those cases where the prevention of exhaustion is either impossible or unprofitable, a considerable readjustment of the rent doctrine is necessary if the assumption of inexhaustibility is to be avoided.

Under the assumption of inexhaustibility land resembles labor in the sense that it perishes through non-use rather than through use. If it is capable of furnishing a valuable service year after year, the failure to utilize it in any year is the source of loss, just as labor suffers loss from unemployment. When, however, it is assumed that the benefits that may be derived from the natural object are exhaustible and non-replaceable, the point of view is altered. The owner of a valuable coal deposit, for instance, desires to derive the maximum benefit from the limited supply which he owns. If for any reason less benefit can be derived by immediate removal and sale of the coal than by waiting until some future time, it may be profitable to postpone utilization.

The simplest condition that might produce this result is an expected alteration in the price of coal. If the price is rising and the prospect is that the rise will

continue, the owner of the mine will find it to his interest to take out but little coal in the present. This is true because the resources at his disposal are limited. Obviously this motive would not exist if the basis of income were perpetual. Likewise a lowering of the prices of those factors which enter into the expenses of production will make profitable a postponement of removal. On the other hand, a decrease of prices of the product or an increase of the prices of the factors of expense, in so far as such changes are continuous or anticipated, will create motives for rapid utilization.

Outside of mere price change, however, the owner of the mine will be moved by still more fundamental considerations. One of these considerations is *diminishing productivity*.¹ According to the Ricardian theory of rent the landowner will find it to his interest to add units of labor and capital to a given surface of land up to the point where the last unit applied just equals the product which might be derived from its employment on marginal land. In familiar phraseology, labor and capital are added up to the intensive margin of cultivation. According to the theory, such a ratio between the factors of production will yield the maximum rental to the landowner, under the given conditions. The exhaustibility of the natural resource, however, dictates a different course. The owner of the mine may well hesitate to proceed beyond the point of maximum average returns per unit of expense.² At this rate of removal the average net return per ton of coal is a maximum, since the average expense of removal per ton is a mini-

¹ This phrase is used to designate the decrease in product which results from the increase in the expenditure for the other factors of production applied to a given surface of land.

² In a strict productivity theory of distribution it would be necessary to continue the comparison of the units of labor and capital instead of substituting units of expense, since the latter assume the determination of the value of labor and capital. In the consideration of the policy of a single entrepreneur, however, it need not be seriously inaccurate to employ the more convenient and more easily illustrated idea of expense.

mum. The attempt to appropriate the coal more rapidly results in a diminishing product per unit of expense and, therefore, a diminishing average net return per ton of coal. Were the mine owner influenced by no other consideration, his interest would demand that no more coal be removed at any time than can be removed at a minimum average expense per ton. If he is willing to wait for the return from his coal, he can postpone for future removal all coal over and above that amount which can be removed at a minimum average expense per ton.

The point may be illustrated by the accompanying table, which shows the results of removing various quantities of coal from a mine during a definite period of time — one year. It is assumed for convenience that each ton of coal is worth \$1.00; so that the same figures represent both the quantity and the value of the product.

TABLE I

Variations in the Net Return in the Removal of Varying Quantities of Coal in a Given Period of Time

Quantity of coal removed (tons)	Value of coal removed (dollars)	Expense of removal per 100 tons	Total net return	Average net returns per 100 tons	Increase in expense due to the removal of each add'l 100 tons	Net return of each additional 100 tons after the point of maximum net returns per 100 tons
100	100	\$120	-\$20	-\$20	...	...
200	200	100	00	00	...	...
300	300	80	60	20	...	...
400	400	50	200	50	...	...
500	500	52	240	...	\$60	\$40
600	600	55	270	...	70	30
700	700	59	287	...	83	17
800	800	64	288	...	99	1
900	900	68	288	...	100	0
1000	1000	73	270	...	...	...
1100	1100	79	231	...	...	...

The figures in the table show that the minimum average expense per ton is achieved by taking out 400 tons of coal during the year. If more than this amount is removed, each ton will yield a smaller net return than if its removal is postponed until it may be effected at the minimum expense. Were the mine an inexhaustible basis of income, there would be no necessity for solicitude on account of the fact that each ton yields less than a possible maximum. The interest of the owner would dictate the extraction of eight hundred tons of coal. At this point the value of an additional one hundred tons just equals the expense of its removal.

It is necessary to turn aside for a moment to consider certain confusions which are involved in the concepts of diminishing productivity and diminishing returns as applied to mines.

Some writers have denied that a mine is subject to the law of diminishing productivity. Altho admitting that the extension of mining to other fields as well as to lower depths may be subject to diminishing return, Professor Marshall appears to deny the diminishing productivity which results from an attempt to accelerate the process of extraction by an increased application of the other factors of production to a given surface. He compares a mine to a reservoir. "The more nearly a reservoir is exhausted," he says, "the greater is the labor of pumping from it: but if one man could pump it out in ten days, ten men could pump it out in one day, and when empty, it would yield no more."¹ It is not denied that the physical possibility suggested by Marshall may occur in some cases. The probability, however, of an indefinite acceleration of the rate of removal without incurring an increased expense

¹ Principles of Economics, bk. iv, chap. iii, section 7. J. S. Mill expressed a similar opinion, but more guardedly, with respect to collieries and other such surface deposits, but not with respect to ordinary mines. Principles, bk. iii, chap. v, section 3.

per unit of result appears to be very unlikely in ordinary circumstances. Even in the case of surface deposits, such as those of the Mesabi Range, the attempt to remove the entire surface supply in a very short period would entail a much larger investment in fixed capital than would be necessary over a longer period. In the case of mines where the sinking of shafts is necessary, an increase of the rate of utilization must often mean the sinking of an increased number of shafts and the provision of a more elaborate equipment than would be required for a lengthier period of extraction. It appears fairly safe to assume that, as a general rule to which there may be certain exceptions, the law of diminishing productivity is applicable to mining as well as to agriculture.

It must be clearly understood that the term *diminishing productivity* as employed above has been used in the sense in which Ricardo used it; that is, with regard to successive applications of labor and capital to a given surface of land. The conclusion that the owner of a mine may stop short of the point where the last unit of expenditure just equals its product constitutes an exception to the modern productivity theory only when the quantity of land is measured by surface. After the quantity of coal to be removed has been determined, the ordinary statement of the productivity theory is applicable. In the removal of that coal expenditures will be profitable so long as an additional outlay facilitates the process of removal to a sufficient extent to justify the expenditure.

The influence of the rate of interest has thus far been disregarded. It is obvious, however, that the tendency for the owner of the mine to postpone for future removal all coal which would otherwise have to be removed at an increased average expense per ton is

counteracted by the fact that the present value of the return from future removal is lessened by the discount on the future. The net return from each ton removed in the present, even at an increased expense, may be greater than the present value of the same coal removed at minimum expense in the future. The basis of comparison, of course, beyond the point of maximum average net returns must be the net return from the removal of an additional quantity of coal (columns six and seven of table one), not the average net return.

TABLE II

Present Values of the Net Returns Derived from the Removal of Various Quantities of Coal at Different Future Periods with Interest at Ten Per Cent

Present Value of	No. Tons	1st Yr.	2d Year	3d Year	4th Year	5th Year	6th Year	7th Year	8th Year
The maximum average net return per 100 tons	400	\$50	\$45.45	\$41.66 +	\$38.46 +	\$35.71 +	\$33.33 +	\$31.25 +	\$29.41 +
Net return of each additional 100 tons.....	500	40	36.36 +	33.33 +	30.76 +	28.57 +	26.66 +	25.00	23.52 +
	600	30	27.27 +	25.00	23.07 +	21.42 +	20.00	18.75	17.64 +
	700	17	15.45 +	14.16 +	13.07 +	12.14 +	11.33 +	10.62 +	10.00
	800	1	.90 +	.83 +	.76 +	.71 +	.66 +	.62 +	.58 +
	900	0	0	0	0	0	0	0	0

Table II illustrates the theoretical method of determining the rate of utilization as a resultant of the two antagonistic factors: diminishing productivity and the discount on the returns from future removal (assumed to be ten per cent). If the total quantity of coal to be removed under the assumed conditions is only twelve hundred tons, there is no reason for the mine owner to remove more than four hundred tons a year; for the present value of the net return of the last four hundred tons removed in the third year is \$41.66, whereas the removal of an additional one hundred tons in the first year will yield a net return of only forty dollars. If

the entire quantity of coal is 3,700 tons, the owner of the mine will find it desirable to remove six hundred tons in the present; for the sixth hundred tons could not be removed at any time in the future so as to yield a greater net return than thirty dollars. If postponed until the eighth year, the present value of the net return is only \$29.41.

In the theory thus far presented, certain conditions have been left out of account for the sake of simplicity. In the first place, it is assumed, with Ricardo, that the landlord has the option of leasing the land to others or of using it himself. This assumes, of course, that the landlord will so adjust the contract in case of a lease that the mine will yield the maximum rent which might be derived from his own utilization. The limitations of this assumption need not be further considered here.

In the second place, the ideal rate of utilization illustrated above implies operation on a large scale in the first year, with a decline in the magnitude of operation in successive years. It will be necessary to employ a larger amount of fixed capital in the first year than in successive years. A part of this fixed capital provided for the larger scale of operation in the first year will be wasted. It will, therefore, pay for the entrepreneur to adjust his rate of removal so that the rate of utilization will be more nearly uniform. This rate will be somewhere between the two extremes represented by the maximum rate of utilization in the first year and the minimum utilization of the last year. A third modification is made necessary by the fact that in the above consideration of the economic rate of utilization substantially constant returns were assumed. No allowance was made for the possibility that the removal of coal in the first year may change entirely the condi-

tions of removal in the second year. The removal of the 400 tons may have exposed coal which is not only of a better quality but also capable of being removed at less expense per ton than the coal removed during the first year. On the other hand, the deposit made accessible by the removal of the 400 tons may be of an inferior quality and so situated that the average expense of removal per ton will be greater than for removal in the first year. This may be true because of greater depth or special difficulties encountered, such as water or gas or the thinness of the vein of coal. In short, mining is subject either to the law of increasing returns or to the law of diminishing returns or to both tendencies alternately according to conditions.¹

The assumption of decreasing returns would not affect the above conclusions. The owner of the mine would have no motive to accelerate the rate of removal of his coal simply to get access to the less profitable coal at lower depths. Under the assumption of increasing returns, however, a more rapid removal in the present might be justified by the fact that the larger net returns from the mine are in the future and are subject to the discount. With this modification the principles of utilization as above outlined will continue applicable.

The influence of differences in the price of the product has thus far been disregarded. In an earlier part of this paper the effect of changing prices was discussed. The influence of higher or lower price levels must now be considered.

It should be noted that, were there no discount on the future, a higher price level would not necessarily change the economic rate of utilization. It might still

¹ Ricardo believed the law of diminishing return is normally characteristic of mining. *Principles of Political Economy*, chap. iii. On the possibility of increasing returns, cf. *Taussig, Principles of Economics*, vol. ii, p. 95.

be economical to extract the coal at the point of maximum average net returns per unit of coal, as determined by the physical conditions of appropriation and the expense of the other factors.

TABLE III

Variations in the Net Return of Varying Quantities of Coal in a Given Period of Time (Price of Coal \$2.00 Per Ton)

Quantity of coal removed (tons)	Value of coal removed	Average expense of removal per 100 tons	Total net return	Average net returns per 100 tons	Increase in expense due to removal of each add'l 100 tons beyond the point of maximum av. net returns	Net return of each additional 100 tons beyond the point of maximum av. net returns
100	\$200	\$120	\$80	\$80	...	...
200	400	100	200	100	...	...
300	600	80	360	120	...	...
400	800	50	600	150	...	...
500	1000	52	740	148	60	140
600	1200	55	870	145	71	130
700	1400	59	987	141	83	117
800	1600	64	1088	136	99	101
900	1800	68	1188	132	100	100
1000	2000	73	1270	127	118	82
1100	2200	79	1331	121	139	61
1200	2400	87	1356	113	175	25
1300	2600	96	1352	104	204	-4
1400	2800	106	1316	94	236	-36

This point is illustrated in Table III, which is similar to Table I, except that the price of coal is doubled. The difference between the average net returns per hundred tons remains the same. The effect of the rise of price is merely to add one hundred dollars to the net return per hundred tons in every case no matter what the quantity removed. The point of maximum net returns is not changed.

Altho a higher level of prices does not necessarily compel a change in the rate of utilization when there is no discount on the future, such a discount will affect the relative merits of present and future removal, and, therefore, the rate of utilization. For under the higher prices the magnitude of the net return per hundred tons, both in present and in future, is increased by the same amount. Because of the increase in the amount of the net return the discount of the net return for a future use will result in a larger deduction in arriving at present value than before the rise of price. Consequently the future use will be relatively less desirable than its competing present use.

TABLE IV

Present Values of the Net Returns derived from the Removal of Various Quantities of Coal at Different Periods with Interest at Ten Per Cent (Price of Coal \$2.00 Per Ton)

Present Value of	No. Tons	1st Yr.	2d Year	3d Year	4th Year	5th Year	6th Year	7th Year	8th Year
The maximum average net returns per 100 tons	400	\$150	\$136.36 +	\$125.00	\$115.38 +	\$107.14 +	\$100.00	\$93.75	\$88.23 +
Present value of the net return from each additional 100 tons..	500	140	127.27 +	116.66 +	107.69 +	100.00	93.33 +	87.50	82.35 +
	600	130	118.18 +	108.33 +	100.00	92.85 +	86.66 +	81.25	76.46 +
	700	117	106.36 +	97.50 +	90.00	83.57 +	78.00	73.12 +	68.82 +
	800	101	91.81 +	84.16 +	77.69 +	72.14 +	67.33 +	63.12 +	59.41 +
	900	100	90.90 +	83.33 +	76.92 +	71.42 +	66.66 +	62.50	58.82 +
	1000	82	74.54 +	68.33 +	63.07 +	58.57 +	54.66 +	51.25	48.23 +
	1100	61	55.45 +	50.83 +	46.92 +	43.52 +	40.66 +	38.12	35.88 +
	1200	25	22.72 +	20.83 +	19.23 +	17.85 +	16.66 +	15.62 +	14.70 +

This point is illustrated in Table IV, in which all the conditions are the same as in Table II except that the price of the product is doubled. At the original price of one dollar per ton the difference in the net return of the fifth one hundred tons in the present, as compared with the present value of the net return per hundred tons when four hundred tons is removed one year from the present, amounts to \$5.45 in favor of the latter.

When the price of coal is doubled, this difference disappears and the balance is in favor of the fifth hundred tons removed in the present. For the net return in the latter case amounts to \$140, while the present value of the net return per hundred tons derived from the removal of four hundred tons in the second year is only \$136.36. If the mine owner has 3,700 tons of coal subject to the assumed conditions of Table IV, he will derive maximum returns from the entire quantity by adjusting his margin of utilization as indicated by the dotted line in Table IV, which shows a more rapid rate of removal than under the lower price. (See Table II.)

Altho the influence of an increase of price is in the same direction as under the Ricardian theory, the intensive margin cannot fall so far that the product and expense on the margin just coincide, as under the Ricardian theory. For, however long the period of utilization may be and however large the discount on the future may become, the net return from the removal of coal at the point of time most remote in the future can never be reduced to zero. Hence, in theory, the competition of this surplus over expense which is marginal in time must always be great enough to prevent the coincidence of product and expense on the intensive margin of present utilization.

If we turn from the consideration of the conditions which determine the intensive margin of utilization to those which determine the extensive margin, the alteration in assumption with regard to exhaustibility does not greatly change the Ricardian formula. It is likely that an extension of the margin will occur whenever such an extension is sufficient to repay the expense of removal. Altho there will be a surplus on the intensive margin, there will be no surplus on the extensive

margin. It has been suggested that while the extensive margin yields no rent, it may yield a royalty: that is, a return to cover the value of the mineral extracted.¹ It will be apparent from the above analysis that this cannot be true theoretically. The value of the coal is due to the fact that it yields a net return above the expense of extracting it: that is, the value is a result of the rent. In order that the coal *in situ* may have a value, the conditions of utilization must be such that the coal may be extracted and sold in the present at an expense sufficiently low to yield a surplus. For, except when the mine is subject to increasing returns as lower depths are reached, or unless prices are expected to change, it is impossible that future uses may yield a surplus unless conditions are such as to yield a surplus in the present. Hence the coal in the mine on the margin which yields no rent, except in the cases above-noted, has no value which could be made the basis of a charge for depreciation. In the case of exhaustible natural objects above the margin of utilization the Ricardian doctrine of rent is characterized by much confusion. Ricardo first sought to rule out all payments for minerals and timber from the category of rent. In the chapter "On Rent" he criticizes Adam Smith very severely for the assertion that the demand for timber and its consequent high price in the more southern countries of Europe, caused a rent to be paid for forests in Norway, which could before afford no

¹ Notably, Professor Sorley in an article on mine royalties, published in the Journal of the Royal Statistical Society for March, 1889; Marshall, A., Principles of Economics, 5th ed., p. 439, note; and Flux, A. W., Economic Principles, pp. 108-109. In his recently published Principles of Economics, Professor Taussig questions the assumption that marginal mines would bear a royalty charge even tho yielding no rent surplus. Professor Taussig does not attempt to prove his point. Professor Sorley bases his position upon the argument that a landowner of a mineral deposit which is marginal must have some inducement to compensate for the necessity of incurring the bad repute of his neighbors on account of the fact that a mine is an unpopular institution. This is a question of fact which need not be discussed here.

rent. "Is it not, however, evident," says Ricardo, "that the person who paid what he thus calls rent, paid it in consideration of the valuable commodity which was then standing on the land, and that he actually repaid himself with a profit, by the sale of the timber? . . . in the case stated by Adam Smith, the compensation was paid for the liberty of removing and selling the timber, and not for the liberty of growing it. He speaks also of the rent of coal mines, and of stone quarries, to which the same observation applies — that the compensation given for the mine or quarry is paid for the value of the coal or stone which can be removed from them, and has no connection with the original and indestructible powers of the land."¹

Strangely enough, in the next chapter Ricardo develops a new doctrine. He appears to disregard entirely his previous positive denial that the return to mines or forests is to be classed as rent. His treatment of the subject is a mere extension of his previous discussion of agricultural rent without modification. "Mines," he says, "as well as land, generally pay a rent to their owner, and this rent, as well as the rent of land, is the effect, and never the cause of the high value of their produce. . . . The metal produced from the poorest mine that is worked must at least have an exchangeable value, not only sufficient to procure all the clothes, food, and other necessaries consumed by those employed in working it, and bringing the produce to market, but also to afford the common and ordinary profits to him who advances the stock necessary to carry on the undertaking. The return for capital paying no rent would regulate the rent of all the other more productive mines. This mine is supposed to yield the usual profits of stock. All that

¹ Principles, chap. ii, section 24.

the other mines produce more than this will necessarily be paid to the owners for rent.”¹ Nowhere in his book does Ricardo make an attempt to explain the apparent contradiction. In fact, the law of mine rent as stated in chapter three is several times reasserted and illustrated, especially the point that the entire net return from a mine is rent.²

Later writers have tried to harmonize the two antagonistic principles developed by Ricardo, by combining them. It has become customary to recognize that the return imputed to a mineral deposit consists of two parts: a rent and a royalty. This plausible doctrine has been maintained by so many writers that it is desirable to devote considerable attention to it.

The essential fallacy of this explanation of mine rent lies in the fact that the so-called royalty is nothing more than a depreciation charge which results from capitalizing a terminable series of incomes. A little attention to Böhm-Bawerk's illustration of the nature of the income from durable goods would have shown clearly that the current distinction between rent and royalty is not sound. Böhm-Bawerk has shown that when the succession of incomes is regarded as interminable, the present value of the most remote in time is nothing. The income in the present is all regarded as interest. When, however, the successive prospective incomes are terminable, the present income is divided into two parts: that is, from the entire net income in the present is subtracted the present value of that portion of the income whose accrual is most remote in time. The remainder is interest; the subtrahend is a depreciation fund, or charge.³ It is this depreciation fund

¹ Principles, chap. iii, section 32.

² Notably in the discussion of the rent of woodland, chap. xii; in the chapter entitled "Taxes on Gold"; and in chap. xxiv.

³ The Positive Theory of Capital (Smart Translation), bk. vi, chaps. vii and viii.

which has been called a royalty. In short, the royalty is the product of the process of capitalization. The business man, unconcerned with socially valid distinctions between rent and interest but desirous of keeping intact his fund of capital, charges to depreciation the amount by which the total value of the mine or farm has been reduced by utilization.¹

To consider that the amount which is left in the present after the subtraction of the amount of depreciation is determined by the law of rent is to confuse the process of capitalization of a rent surplus with the conditions which determine rent itself. This amount which is regarded as the economic rent of the mine, as distinguished from the so-called royalty, is obviously a quantity which varies with every change in the rate of interest and with the degree of remoteness of exhaustibility. The true rent, indeed, in the present is not simply this amount; rather it is the whole surplus as determined by the difference between the gross product in the present and the expenses of production.² It may be said that there can be no objection to calling this depreciation fund a royalty. This is true. The objection lies in applying the term *rent* to the *residuum* after the subtraction of the so-called royalty from the total net return. For the actual amount of this so-called rent is not determined in amount by the conditions which give rise to a surplus over the expense of utilizing natural agents. It is determined mainly by

¹ Mr. J. A. Finlay, a New York mining expert employed by the State of Michigan to appraise the mines of the state for purposes of taxation, has recently used this method of capitalization in the valuation of Michigan mines. An account of the appraisal is published by Mr. Finlay in the *Engineering and Mining Journal* for September 9, 1911, p. 488.

² In the article on mine royalties already referred to, Professor Sorley recognizes the identity of rent and royalty so far as mines above the margin are concerned. As already pointed out, he attempts to show the existence of the royalty in the case of marginal mines. Professor Sorley does not attempt to explain the nature of this royalty.

the process of capitalizing such a surplus. Only indirectly is the surplus responsible for the size of this pseudo-rent, as the whole may limit the size of its parts. Inasmuch as the removal of all coal in the present, beyond the point of maximum net returns per unit of coal, is subject to the competition of future uses; it might be considered that the value of all coal extracted beyond this point is subject to an opportunity cost measured by the present value of the net return which would be derived from the coal if extraction were postponed until the future. Even this opportunity cost does not represent a value of coal in addition to the rent surplus; for the entire surplus in the present is none the less a real surplus merely because a smaller return in the future could be derived from the same coal by postponement of utilization.

The relation of mine rents to price has naturally been the subject of much confusion. Generally speaking, modern writers who have given attention to this subject have taken the position that royalties "enter into price" although the so-called rent of the mine does not. This position is maintained on the ground that the royalty is a capital fund which must be remunerated in order to induce the owner of the mine to employ it productively.

It is now generally recognized that the old idea that rent does not "enter into price" does not imply that rent may not be a determinant of relative prices. The question, then, of the relation of royalties and of rents amounts to this: are they forms of income which are disposable? If they were partly or entirely taken by taxation, would the supply of land be decreased?

In this sense a royalty may "enter into price" under certain conditions, and under other conditions it may not enter into price; but in no case is its relation to

price attributable to the fact that the royalty is capital which must be replaced. The entire pseudo-rent and nearly all the royalty might be taken without causing the mine to fall below the margin of utilization. For, since the royalty itself is a part of the total surplus, the owner would be foolish to abandon his mine so long as any surplus is obtainable. What will happen is that the *residuum* of the old royalty will be recapitalized and divided into a new royalty, and a new rent. The actual amount of each will be determined by the conditions of capitalization.

It does not follow, however, that a tax on the mine will in no way affect the supply of the product placed on the market in the present. Such a tax may disturb the relation between present and future. It has been shown that the tendency is for the rate of utilization to be so adjusted that the present value of the marginal uses in present and in future are just in balance. Much, therefore, will depend on the manner in which the tax is applied.

An annual tax on the value of the mine, provided the tax is expected to be permanent, will increase the tendency for the mine owner to remove the coal in the present rather than in the future. For, since the mine must pay the tax as long as it is operated, the tax may be evaded by increasing the rapidity of exhaustion. This will be true even if all of the so-called rent and a part of the royalty is taken by the tax. Far from preventing the mine from being utilized, it will actually increase the amount of coal placed on the market; and if demand is constant, will probably lower price.

On the other hand a tax upon the annual surplus from the operation of the mine, even if it is so heavy as to take more than the pseudo-rent, will not create an inducement for the mine owner to alter the adjust-

ment of utilization between present and future. If the rate of extraction is already adjusted upon the most profitable basis, nothing will be gained by postponing until the future, coal that will yield a greater net return in the present. For the tax can be avoided only to the extent that the surplus return is reduced, and the loss in surplus must always be greater than the saving in the tax. The effect of such a tax is to take a certain share of each dollar of surplus whenever it appears, whether in the present or future. The tax can only be evaded by losing that part of the dollar which remains. This is true on the assumption that the tax is regarded as permanent. Of course, in any case, if the tax is regarded as merely temporary, the tendency will be to transfer as much as possible of the process of production to the future.

In the case of a tonnage tax consisting of a fixed amount per ton, the balance of motive between present and future will probably be affected in such a way as to encourage a slower rate of utilization, and the postponement of a greater amount of coal for future extraction. If, previous to the levying of the tax, the marginal net return from coal to be extracted in the present is in equal balance with the present value of the marginal net return from future uses, the tax will reduce the net return of a given quantity of coal which is on the margin of utilization in the future less than it will reduce the net return in the present. This is true simply because the future tax is discounted. For instance, suppose that the marginal present use yields a net return per ton of one dollar while a competitive future use twenty years from the present will yield a net return of two dollars per ton, the present worth of which is one dollar (assuming a discount at five per cent). A tax of ten cents per ton will leave the net

returns of present and future ninety cents and one dollar ninety cents respectively. The present value of the future coal, however, is ninety-five cents instead of ninety cents, indicating the probability that a lower rate of utilization will be adopted.

The consideration of the incidence of taxes on mines makes clear the fact that the royalty is not a necessary part of supply price. The entire rent and part of the royalty may be taken without affecting supply provided it is done in such a manner that the relation between the net returns from present and future production are not disturbed.

It will now be apparent that of the two solutions which Ricardo applied to the problem, the idea that the rent of a mine or forest comprises the entire surplus above the expenses of production is the more nearly correct explanation. At the same time, Ricardo was not justified in extending his theory of rent to exhaustible natural agents without modification, especially when the rent-bearer is exhaustible and non-restorable. For the location of the internal margin of utilization is determined by the competition of present and future uses rather than by the coincidence between product and expense. Consequently the rate of interest exercises an important influence in determining the location of the internal margin. On the other hand, the price level of the product has substantially the same influence upon the rate of utilization as under the Ricardian assumptions. Moreover, there is no alteration in the method of determining the extensive margin; altho, when the comparison is between surfaces, the intensive margin does not coincide with the extensive margin.

These modifications do not necessarily nullify the conventional statement that rent is the difference between the product of a given amount of labor and

capital applied to good land in the most profitable way and the product of an equal amount of labor and capital applied to marginal land. It is only necessary to give a special interpretation, as above, to the phrase "*in the most profitable way.*" However, the traditional division of the net return from exhaustible natural resources into a rent and a royalty is justified only as a method of capitalization. The real economic rent of such resources comprises the entire net return from the rent-bearer, including the so-called royalty.

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