RAILWAY RATES

This article, which was published in the Economic Journal, 1912, as the second section of the series announced as "Contributions to the Theory of Railway Rates," deals with some leading problems in Railway Economics. The function of discrimination is investigated on the lines of Dupuit. There comes up for reconsideration the vexed question of the relation between through fares lowered by competition and fares to intermediate localities which are subject to monopoly. The discrepancy in this matter between expert practice and abstract theory is explained by the circumstance that the theory may be too abstract, not taking into account the monopolist's concern for interests in the distant future. The monopoly also may be not pure, but mixed with competition or altruistic motives. A return to the subject is promised; but this is one of the promises which were swallowed up by the War.

The classical economists rather anathematized than analysed monopoly. 1 It was reserved for Cournot to cultivate this neglected branch of economies; gathering the first-fruits of the mathematical method. Cournot and his mathematical successors have fully discussed what may be called the leading case: that of a monopolist dealing with a whole class of mutually competitive customers at one and the same price. Some acquaintance with the laws governing this comparatively simple case is here presumed. My contributions are directed to a subject less generally studied, 2 the case in which the monopolist discriminates between different classes of customers. I build upon the foundations laid by Dupuit. 3

1 For instance, Adam Smith's dictum, "The price of monopoly is upon every occasion the highest which can be got" (Wealth of Nations, Book I. chap. vii.); J. S. Mill's dictum, "Monopoly value does not depend on any peculiar principle, but is a mere variety of the ordinary case of demand and supply" (Political Economy, Book III. chap. ii. § 5), were wanting in precision.
2 See his epoch-making papers, De la mesure de l'utilité des travaux publics and De l'usage des pénalités sur l'utilité in the Annales des Ponts et Chaussées, 1844 and 1849, which will be found among the periodical publications in the library of the British Museum. Some extracts from Dupuit's papers are given in my article in the Economic Journal, September, 1910.
The corner-stone of this building is formed by a conception which Dupuit introduced under the designation "rente des acheteurs" : the money-measure of the benefit accruing to purchasers from obtaining articles which they purchase at a certain price, while they would have been willing to give more for those articles rather than go without them altogether. The sum of money designated by the term in question may, I think, be an object of science as well as the sum designated by the more familiar term price. The monetary equivalent of total utility may be as objective as the monetary equivalent of final utility. It should be observed, too, that often the Rente des Acheteurs with which we are here concerned does not consist only of Consumers' Surplus in the phrase adopted by the second founder of the theory, but also of a certain Producers' Surplus which consists of money, and does not require, like Consumers' Surplus for the most part, to be evaluated by an unusual or hypothetical transaction. Thus, if a railway lowers the rate for carriage of coal to a residential and manufacturing town (dependent on that railway for its supply of coal), not only will there be a gain of Consumers' Surplus to those who use coal for domestic purposes, but also the manufacturers becoming able to extend their use of coal in various directions will presumably secure a greater surplus of money profit. I propose to subsume the two kinds of advantage which may accrue to the purchasers of monopolised services under the title "Customers' Benefit."

The theory which I attempt to construct is based mainly on the first principle of pure economics, the prevalence of self-interest. In the words of Professor Cohn, comparing the different motives by which railway managers are actuated, "by far the weightiest are assuredly the egoistic motives." 1 In the words of another high authority: 2 "the constant effort of every railway company [is] to secure the volume of traffic and to maintain the fares that will jointly yield maximum net profit." "The main purpose of the railway manager is to secure present or prospective profit for the stockholders." 3 But while reasoning from this premise, I do not forget that a concrete railway company is far from being a perfect monopoly; and I will point

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1 "Weiters die wichtigsten sind allerdings die egoistischen." *Engelsche Blätter*, vol. ii. p. 296, and contrast evidencing evidence that "das Eigennut" is the predominant motive.
3 A qualification of this assumption, made by the distinguished writers, will be noticed in the sequel.
out how the deductions from the abstract principle require to be
modified by other considerations.

(1) Discrimination due to differences in demand.—The most
characteristic case of discrimination resulting from monopoly
occurs when different charges are made for like commodities
solely on account of differences in value to the purchaser, and
quite irrespectively of differences in cost to the producer. Ex-
amples of this case too familiar to require citation occur through-
out the wide fields of railway practice ¹ designated by the terms
Classification and Local Discrimination.

To explore the consequences to the customers of such dis-
crimination, let us at first suppose that no very great difference
of rates—no "wrench in commercial conditions" in the phrase of
an experienced railway manager ²—is caused by the introduction
of the discrimination. Let us further provisionally assume that
the company's interest in the two kinds of traffic—say through
traffic and local traffic—is not very unequal. We have then the
typical case which I have discussed at length in a former paper.³
It is there shown that the perfectly self-interested monopolist
tends to exploit the customers in such wise that their last state
will be worse than their state prior to discrimination. But, as
it is further shown—by an extension of a theorem pointed out by
Dupuit and applied by M. Colson—the monopolist has not much
interest in pushing his exploitation up to and beyond the limit
at which discrimination begins to be detrimental to the customers
as a whole. For a small consideration the monopolist can probably
be induced to adopt a set of prices such that the cus-
tomers as a whole—as well as the monopolist himself—may be
gainers through discrimination.⁴ If he does not insist on extract-
ing the utmost farthing, discrimination will result in an increase
of Customers' Benefit.⁵

¹ As shown by all intelligent writers on the economics of transportation, with
particular boldness by Hadley and Aensworth.
² R. P. Sipley in the context of a passage quoted in the sequel.
³ Applications of Probabilities to Economics, ¹, II, 497.
⁴ The instances of discrimination alleged by Schipper in his interesting study
on the passenger service of Prussian railways (Volkswirtschaftliche Studien, Berlin:
Heft 299) as detrimental to the public—for instance, between "returns" and
ordinary rates—are hardly relevant here, so far as the allegation rests on the differ-
ences in the value of money to different classes of the community. This is a
consideration not taken into account here.
⁵ This last proposition is a new corollary, which the mathematical reader will
have no difficulty in deducing from the theory given in the paper of 1910; upon
the assumption not only that the coefficients $a, b, c, \ldots,$ pertaining to the demand
curves (loc. cit., p. 469, note), are small, but also that the monopolist takes no
account of amounts (of profit) less than what correspond to the squares of those
As we leave the limiting case in which the receipts prior to discrimination are nearly equal and the discrepancy in prices produced by discrimination is inconsiderable, the probability in favour of the conclusions enounced becomes weaker. The lamp of Probability is dimmed when the inequality between the original demands is considerable, but not immense. Penetrating this obscure central region we emerge into daylight as we approach a new limit characterized by the extreme inequality of the receipts prior to discrimination. One class has now so small a demand, in the absence of discrimination, that the alteration of its price does not sensibly affect the other class constituting the bulk of the customers (prior to discrimination). There are two varieties of this extreme case; the rate fixed for the exceptional class may be either raised or lowered. An example of the first variety would occur if millionaires were treated as coresident discretion, in Mr. Asworth’s phrase. But probably in the management of railway traffic this variety is much rarer than the converse one in which rates are lowered for outlying classes.

This category includes the cases in which judicious managers "create traffic" and "excursion business, handled at reduced fares," in contrast to "the regular business at standard fares," and "extra traffic that will not move without special conditions." When we may place walking and cycling tickets, week-end, and "long-date week-end" tickets, special terms offered to passengers on the occasions of exhibitions, football matches, etc.; with like discrimination in favour of producers. Now in all such cases there is a pure gain of Customers’ Benefit; since by hypothesis the position of the bulk of the customers is unaltered, while

small magnitudes. The concavity, it may be observed, is true independently of the form of the demand-function, since in the expansion of these functions the terms involving higher powers than the second may be neglected.

1. Loc. cit.
2. Loc. cit., p. 231.
3. Theoretically the light does not return until we have crowded the new limit into an outlying region occupied by customers who have no demand at the original (undiscriminated) price. But practically it may be often assumed that the very small demand of a special class will not have a sensible effect on the rates fixed with regard to the demand of the majority.
6. Many such instances are given by H. Marriott, The Pricing of Rates and Fares, chap. vi. Perhaps some of the instances are not quite at (or beyond) the limit under consideration. Thus, the demand for week-end journeys might well be so great and of such a nature that, if special week-end fares were to be abolished and a uniform fare adopted, that undiscriminated charge would be—practically, as well as theoretically—lower than the present standard fare.
the remainder are enabled to purchase a commodity of which the
price was previously prohibitive.

(2) Discrimination due to differences in cost.—An equally
simple and perhaps more familiar case arises when two classes
of customers \(^1\) between whom it is proposed to discriminate
have the same demand for a commodity which it costs more to
supply to one than to the other. For instance, the two classes may
be the residents in two localities, whose dispositions with respect
to local journeys are identical; but the operating expenses \(^2\) may
be greater—say on account of the steepness of the gradients—in
one place than the other. The reader will rightly presume,
though probably for the wrong reason, \(^3\) that when the price of
the two services is not constrained to be uniform, the price of
the service which it costs more to supply will (theoretically) be
higher. But preconceptions will be of little avail to answer the
question whether under the circumstances the customers as a
whole will be benefited by the discrimination. The Ricardoian
doctrinaire will presume that prices proportional to costs of
production form the best possible arrangement. The undis-
ciplined Socialist may presume that equal charges for classes
whose wants are identical are productive of maximum satisfac-
tion. But both these contrary presumptions are incorrect.
The first thesis is only approximately true; the second is false.\(^4\)

(3) Discrimination due to differences in both demand and
cost.—Now let us compound the two preceding simple cases.
For instance, the discrimination between first- and third-class
passengers' fares (in England) is, I suppose, based partly on the
different requirements of the passengers, and partly on difference
in the cost of equipment. In this case the same line of cleavage
separates the classes which are discriminated in respect of demand
and in respect of cost. \(^5\) More generally, it may be conceived
that the two classes differing in one of those respects, for instance,
the residents in the two localities for which the cost of carriage

\(^1\) It may be well to repeat here the advertisement which I gave at the outset of
the cognate paper in the Economic Journal for 1919—"I shall for convenience
of accommodation confine my statements to the variety in which only two species are
discriminated; but the propositions thus enunciated are readily adapted to any
finite number of species."

\(^2\) The general arguments are not relevant to the present theory.

\(^3\) On the strength of Ricardo's premises inappropriate to the present inquiry
which relates to pure monopoly. The true reason is to be found in Cournot's
theory concerning the effect of a rise in cost of production on the price of a
monopolized commodity.

\(^4\) For proof of these and following statements see the paper on the Application
of Probabilities, Section VI., p. 3. (2) of my book.

\(^5\) Loc. cit.
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was different, have a uniform demand only on an average; each class capable of being broken up into species, such as travellers by fast and by slow trains. We may then employ first one of the above propositions, then the other, to obtain conclusions analogous to those which have been enunciated.

It remains to notice the modifications of the simple propositions which arise when we introduce correlation 1 both of demand and cost. For instance, the demand on the part of passengers for first-class and that for third-class accommodation are rival. The demands for the carriage of the passengers themselves and for the carriage of their luggage (where, as in Prussia, a separate charge is made for luggage) are presumably complementary. In the case of special tickets for "parties" 2 we have an instance of complementary demand, so far as the desire of each for the trip is heightened by the pleasure of company; and of joint cost so far as the largeness of the party enables the economies of production on a large scale to be realised. 3 But it will not be necessary to examine in detail the variety of cases which are constituted by these complications. The subject is particularly open to the remark which Mill quotes from Montesquieu: "Il ne faut pas telllement épouser une chose qu'on ne laisse rien à faire au lecteur." The reader is invited to ascertain for himself, with the aid of the notes in the former paper, 4 that the propositions above proved for the simpler cases of demand and supply may be extended to cases complicated by Joint Demand and Cost; the probability becoming more a a priori 5 and of less practical service as the complications increase. The mathematical reader will have no difficulty in making these generalisations if he bears in mind the essential characteristics of our theory, namely, (1) that monopoly profit is at a maximum 6 (before and after discrimination), and accordingly that the data must be such as to fulfil the usual criteria of a maximum; (2) that the coefficients which determine the extent of the discrimination are, at least, initially small; 7

1 The term is defined and divided, 8, 9, 172, 17.
2 For instances of such arrangements, see the passages of Johnson and Haubein's Railway Traffic and Rates, referred to above, p. 176.
3 See, as to the relation of Joint Cost and Increasing Returns, passages referred to in the Index.
4 See C, p. 423, et seq. The treatment of Correlated Cost is exemplified below, p. 196, et seq.
5 See Op. II.
6 In accordance with the fundamental premises postulated above, p. 172.
7 Relatively small (such as the coefficients a, b, etc., employed in the note to p. 174, above); partly in accordance with the practice of railway managers (alluded to below, p. 195), but principally in virtue of a method of reasoning introduced by Cournot and largely applicable in mathematical economics; as to which see Index s. v. "Differentials and Finite Differences."
(3) that the usual postulates of a priori probabilities \footnote{As to a priori Probabilities, see passages referred to in Index.} are granted; in particular, it is assumed that if two quantities \( P \) and \( Q \) take on from time to time different values (ranging through tracts of the same order of magnitude), such that \( P \) is always positive, \( Q \) as often positive as negative, then (under the circumstances characterising the class of problems with which we are dealing) the sum \( P + Q \) is probably positive.

With reference to the complex cases, it may be well perhaps to explain what is implied in my use of the evasive term Joint Cost. When it is said in the present context that two discriminated commodities have a joint cost, it is meant that when the production of one is increased by an amount such as that which results from the discrimination contemplated,\footnote{Quarterly Journal of Economics (1891); reprinted in Pigou's Railway Problems (p. 140, et seq.).} then the increased production of the other commodity becomes less costly. It is true that most of our examples seem to imply Joint Cost on a different scale. Thus, the two ports of the same railway which were instance in our second subsection would, no doubt, have a joint cost in virtue of the initial expenses of the railway. But we might equally have supposed two distinct railways, owned by the same company, similar as to the requisites of customers, differing only in that the cost of haulage is greater on one of them than in the other. So with respect to our first problem we might suppose two separate lines (owned by the same company) on one of which lime destined for agricultural purposes, on the other line destined for architectural purposes is hauled, at different rates, though the cost (per ton) of haulage is the same.

It thus appears that the distinction drawn by Professor Taussig \footnote{As to the propriety of applying the magnitude of the "dimes" considered with reference to Joint Cost, and generally Laws of Return, see 0, above, pp. 68, et passim.} between the discrimination resulting from Joint Cost.
and that which results from Monopoly, however important in general, is not particularly relevant to the benefit accruing to customers which we have in view. This sort of benefit may be obtained from discrimination without Joint Cost in a regime of Monopoly, and with Joint Cost in a regime either of Monopoly or of Competition. Our writers are unavailing by the observation that "people constantly confuse the principle of joint cost with monopoly. To charge what the traffic will bear under the former principle is for the public interest, to charge what it will bear under the latter principle is against the public interest."\(^1\) The public interest which most writers outside the school of the *Ponts et Chaussées* connect with joint cost and discrimination of price is the circumstance that but for such discrimination the production is apt to be unprofitable and therefore impossible.\(^2\) But the public interest which I here, after Dupuit, emphasise, is one quite distinct from that familiar advantage. It is sometimes, indeed, superadded thereto, but it often exists independently. It consists in minimising through discrimination that loss (perte abaque in M. Colson's phrase) of customers' benefit which is apt to result from unitary price. Doubtless competitive joint-cost is more in the public interest than monopolistic joint-cost, other things being the same. But other things are likely not to be the same, since monopoly is more favourable to discrimination.\(^3\)

(4) Changes in demand.—Having now considered the influence of demand and cost as determining discrimination, let us go on to consider changes in those factors.\(^4\) The question arises how will a change in the demand for one of the commodities discriminated affect the result of discrimination. The change may be supposed, with sufficient generality, to occur after the introduction of discrimination. The commodities which we have hitherto considered may be likened to two horses of different mettle at first yoked together and constrained to go at one and the same rate; afterwards unyoked and free to go each at its own pace. The question now arises, if, after the separation, one of the steeds be either spurred or reined, what will be the effect on

\(^2\) As in the "oyster-case" which Principal Halden has made classic; referred to above, C, p. 93.
\(^3\) As to the possibility of monopoly being better for the customer than competition, see D, p. 101, et seq., and E, p. 406 seq.
\(^4\) The relation between the following two subsections and the preceding three may be illustrated by the relation between § 2 and § 6 of MR's chapter on *International Values*, dealing respectively with the level of values resulting from the opening of trade, and the change in the level resulting from a variation of the date.
the rate of the other. The metaphor suggests the true answer, namely, nil, in the absence of special relations, whether of rivalry or sympathy. Thus, if a Company has been free to adopt the rates that are most profitable at different distances (say, arbitrarily tapering rates), then a fall in the demand for through traffic occur, through the construction of a competitive line passing through a distant point, that circumstance per se will not theoretically affect the fares for shorter distances. They had already been fixed at the amounts supposed to be most profitable; to alter them on account of some loss occurring elsewhere would mean but an additional loss of profit.

This deduction from abstract theory is at variance with the judgment of experts.

Thus, the experienced Albert Hink testifies that a hard-and-fast tariff (preventing discrimination) "would have the effect that they would have to increase their charges upon such portions of the road as they could control themselves." (Report of the Hepburn Commission, Vol. I. p. 68.)

So in the classical pages of C. P. Adams we read:—

"At one point" rates became almost literally nominal; residents "at other points would be charged every penny that they could be made to pay without being drawn off the railroad and back to the highway." (Railroads, 1878, p. 123.)

The high authority of Professor W. Z. Ripley may be quoted in favour of the prevalent doctrine:—

"In the constant pressure for reduced rates in order to widen markets, it is not unnatural that the intermediate points, less competitive probably, should be made to contribute an undue share to the fixed sum of joint costs." (Political Science Quarterly, Vol. XX.; 1896, Railway Problems, p. 489.)

And, again, Professor Ripley speaks of "the danger of local rates . . . being actually enhanced, or at least prevented from reduction because of an unduly low level of competitive rates at more distant points." (Quarterly Journal of Economics, 1909, p. 481.)

To the same effect the aunts H. Turner Newcomb:—

"To these stations the relation of the railway is that of a monopoly, and from them the latter can and will . . . recoup all losses that may be sustained." (Railway Economics, p. 47.)

"Competition at terminal points impels most railways to charge relatively high rates at intermediate points, the traffic of which cannot be diverted to other lines." (Op. cit.)

How strongly this doctrine of recoupment recommends itself
to enlightened common-sense appears from its continual recurrence in the reports and decisions of the Inter-State Commerce Commission. For example:—

"The greater the departure from the direct line, the greater would commonly be the necessity for lower rates on through traffic, and the greater the liability to have the charges on the local traffic increased to make the carriage of through traffic possible." (Quoted from the Decisions of the Inter-State Commerce Commission, Vol. 1., by Hugo Meyer, Regulation of Railway Rates, p. 355.)

Through rates "must not be so low as to burden other business with part of the cost." (Inter-State Commerce Commission, Third Annual Report, p. 126.)

"If the rate is too low upon one article, in the end other articles pay too high a rate." (Quoted by Ripley, Railway Problems, p. 466.)

And who pays for this loss [occasioned by a roundabout service to competitive points]? "Ultimately the intermediate points." (I.C.C. Annual Report, Vol. XL, p. 45.)

A similar contradiction between abstract theory and expert judgment may be noticed with respect to the practice of giving free passes to passengers. Theoretically, if from a homogeneous body of customers some are selected to pay for their journeys by some service to the general interests of the company, that variation of the terms for certain passengers does not prima facie affect the rate for the other passengers; what was before the rate affording maximum profit still fulfils that condition. But this theory is not in accordance with common opinion. Thus, the Ollom Commission complain (inter alia):—

1 If, as is sometimes objected, the favoured persons belong to the wealthier class (and so have a higher effective demand for passenger service)—"men of wealth and prominence who ride at the expense of others less able to pay" (I.C.C. Annual Report, Vol. III, p. 11)—then the discrimination would tend to lower the rates of the other passengers (by the theory of our subsection 1).

To continue our epigram metaphor, we have (1) in the case of homogeneous demand a horse of like mettle with others running abreast of them at the same pace without any constraining yoke. The removal of such a one to be employed elsewhere does not tend to alter the general pace. But (2) if the horse removed is one of higher mettle, which ran at the same rate as others only through constraint, the removal of such a one tends to lower the general rate.

One of the few writers whom I have found on any side in this matter is Marshall Kirkman, who considers what I consider the (provisionally) true doctrine in his Basis of Railway Rates, p. 38:—"Making of a low rate never has the effort to raise another rate. Each is independent." But I do not claim the alliance of a writer who holds that the charges "for railway service are governed by the same laws that fix the price of other necessaries" —"fish or flour" (p. 26), "what we may term God's natural laws."
"That the cost of the passenger service is largely increased by this abuse" [the granting of passes]. (P. 901, quoted by the Elkins Commission.)

So A. B. Stieckney:—

"To charge one person two prices for the sake of carrying another free" [seemed outrageous]. (Railway Problems, ch. viii.)

So the Inter-State Commerce Commission:—

"Favoured persons have been furnished free transportation at the expense of the general public by higher general charges to reimburse for gratuitous carriage." (Annual Report, III. p. 12.)

These antinomies between abstract reasoning and common opinion appear to be due principally, but perhaps not altogether, to the admitted inadequacy of the premises stated at the outset, and so far employed without correction, the prevalence of perfect and perfectly self-interested monopoly.¹

It remains under this head to consider the special cases in which there is a correlation, a sympathy, or rivalry,² either in respect of production or demand, between the commodities for one of which the demand is changed. Thus, a fall in the demand for through traffic (owing to competition at a distant point), not met by a lowering of through rates, might be followed by a shrinkage of the through traffic, with a loss of the economies attending production on a large scale that would involve a rise of the fares for shorter distances. To exemplify correlation of demand (between the commodities for one of which the demand is altered), suppose that in a country where a separate charge is made for passengers’ luggage the demand for travel increases (without any decrease in the amount of luggage required on each journey); then the demand for the carriage of luggage would be increased, and therefore presumably the charge for carrying luggage might be raised.

The last conclusion requires some qualification, for it is one of the paradoxes of Monopoly as contrasted with Competition, that a rise in demand, even under monopoly without discrimination, as shown in another paper,³ is not necessarily attended with a rise in price. It is thus not exactly true to say with Ricardo that "commodities which are monopolised rise in price in proportion to the eagerness of the buyers to purchase them." ⁴

¹ Op. subsecl. 6, 7, and 8 below.
² The cases illustrated above, p. 177.
³ Above, p. 164.
⁴ Principles, ch. xxx.
This paradox has not any important, or rather not any recherché, analogy under the head of cost.  

(5) Changes in cost.—The antithesis between theory and common opinion recurs when we consider the case in which the cost of transportation is changed for one of the discriminated services. In the absence of correlations there is no reason why the rate for the other service should be altered. Thus, if Government should compel railways to carry particular classes—say soldiers or workmen—at unprofitable rates, yet, supposing that the railway was previously free to fix discriminating rates at its discretion, the other classes of customers need not suffer. Because the Government smites the Railway on one cheek, is that any reason why the Railway should smite itself on the other cheek by altering fares arranged to yield maximum profit? But such is not the received opinion, which is thus well expressed by Mr. Pratt:

“If workmen are to be regarded as a privileged class who must be carried to and from their occupations at fares or under conditions which do not pay a railway company, then it is obvious that the difference must be made up either by other classes of travellers, or by the general body of the traders.” (Railways and their Rates, p. 41.)

So far supposing that there is no correlation between the discriminated services. Now let there be such a relation; and first, let there be a rivalry of demand as for first-class and third-class passenger service. In such a case, as I have shown at length in other papers, a rise in the cost of one service may not only not cause a rise, but may cause a fall in the charge for the other service. The proposition is principally important as giving a shock to the obstinate convictions of the half-taught, who persist in transferring to a regime of pure monopoly the lessons which they learnt in their youth when competition held, in the books at least, undivided sway.

A similar interest attaches to a corresponding case of correlations between costs. For instance, suppose that goods and passenger services are so related, on a crowded line, that if the one is increased the other becomes more costly. Let the cost of the passenger service be increased by any cause not directly affecting the goods traffic. The Ricardoian will rightly presume

1 The analogue is the theorem that an increase in the total cost of producing each amount of a commodity (Cournot’s 𝜶𝑖(𝑐) as distinguished from his 𝑔𝑖(𝑐)) is not necessarily attended with a rise of price in a regime of pure monopoly.

2 Above, E, p. 122; I, p. 140.
that the charge for passenger service will tend to rise. But he is likely to have a wrong opinion on the question whether the customers of the railway as a whole may be benefited by the change. By a parity of reasoning with that employed in the case of correlated demand, it may be shown that the increase in the cost of one service may quite possibly be attended with an increase of Customers' Benefits—more beneficial to the shippers and consumers of the goods than it is detrimental to the passengers. The proposition has some affinity to Dr. Marshall's celebrated paradox as to the conditions of maximum satisfaction.¹

Both theories conduce to the same purpose, to awaken old-fashioned dogmatists from their optimistic slumber. But the analogy is not close, as appears from the observation that inelasticity of demand for the commodity of which the cost is raised is not a condition favourable to the effect here considered.²

¹ Principles of Economics, Book V, ch. xii.

² The general truth may conveniently be conveyed by way of a particular example. In a notation similar to that employed in an earlier paper (above, E, p. 132) let \( p_1, p_2 \) be the prices of the two commodities referred respectively to the prices at the point of equilibrium; let \( q_1, q_2 \) be the corresponding, similarly measured, amounts of commodity. Let the laws of demand (not now correlated) be expressed by the equations:

\[
x_1 = \frac{a}{p_1} + \frac{b}{p_2}; \quad x_2 = \frac{c}{p_1} + \frac{d}{p_2}
\]

Let the (now correlated) cost of producing the quantities \( x_1 \) and \( x_2 \), any \( K \)

\[
K = c' + \frac{e}{p_1} + \frac{f}{p_2} + \frac{g}{p_1} + \frac{h}{p_2}
\]

where \( C' \) is a coefficient representing general expenses, which, with reference to the present operation, may be treated as constant. The values of \( x_1 \) and \( x_2 \) for which the profit of monopoly \( (p_1q_1 + p_2q_2 - K) \) is a maximum are then as they ought to be, each unity.

Now let the (total) cost of production be increased by an expense proportional to the amount produced of one commodity, say the additional expense \( v \), where \( v \) is small. By the method explained in a former paper it will be found that the resulting increments of \( x_1 \) and \( x_2 \) are approximately:

\[
x_1 = -\frac{a}{p_1^2}v; \quad x_2 = -\frac{d}{p_2^2}v.
\]

The corresponding increment of Customers' Benefits is

\[
-\Delta p_1(x_1 + \Delta x_1) - \Delta p_2(x_2 + \Delta x_2)
\]

\[
= -\Delta p_1x_1 - \Delta p_2x_2 + \frac{1}{2}(e + f)\Delta v
\]

Substituting for \( \Delta x_1 \) and \( \Delta x_2 \) the values above found and neglecting quantities of the second order, we have for the increment of Customers' Benefits \( \Delta \gamma \), that is, a positive quantity. [A smaller (positive) value was before inadvertently given.]

More generally put for the increment of Customers' Benefits (approximately)

\[
\Delta \gamma = \Delta p_1 + \Delta p_2 - \Delta p_1x_1 - \Delta p_2x_2 - \frac{1}{2}(e + f)\Delta v
\]

where \( \Delta p_1 = \frac{\partial^2 p_1}{\partial x_1^2} \), and \( \Delta p_2 = \frac{\partial^2 p_2}{\partial x_2^2} \) (there being no correlation of demand).

By reasoning of parity with that before employed (E, p. 131)

\[
\Delta \gamma = \frac{\partial \gamma}{\partial x_1} \Delta x_1 + \frac{\partial \gamma}{\partial x_2} \Delta x_2 - \frac{\partial^2 \gamma}{\partial x_1 \partial x_2} \Delta x_1 \Delta x_2
\]

where \( \gamma \) as before is the monopolist's gain, \( D \) is necessarily positive, \( \frac{\partial \gamma}{\partial x_1} = -\frac{\partial K}{\partial x_1} \), and \( \frac{\partial \gamma}{\partial x_2} = -\frac{\partial K}{\partial x_2} \).
(6) Future interests. — "So far we have supposed the owner of a monopoly to fix the price of his commodity with exclusive reference to the immediate net revenue which he can derive from it." I use Dr. Marshall's words¹ to mark the transition to cases in which the monopolist may alter his price "with a view to the future development of his business."² The development of his own business by developing the business of his customers, at a sacrifice of present to future profit, is more readily practised by the monopolist than by the entrepreneur in a regime of competition, as the monopolist has an assurance that the fruits of his sacrifice will not be snatched by a competitor. With this view intelligent railway managers often fix rates lower than those which would afford maximum profit in the present. To encourage future traffic "a railroad operating in a new territory may for a time offer to carry freights at rates which barely cover expenses."³ They may even "haul materials at a loss."⁴ Coal, hay, grain, "are sometimes carried at less than the total expenses."⁵ Freight is sometimes carried at a loss to get some other freight that will pay more.⁶ The concurrence between the interest of the monopolist and his customers, which was before seen to be approximate, seems now to be complete. There is presented an optimistic view of dynamical discrimination comparable to Bishop Butler's doctrine that rational self-love and universal benevolence are nearly coincident in this life and completely when account is taken of the future.

It is true, indeed, that in the words of an able writer, "traders' and railways' interests are in the long run coincident."⁶ But the traders of whom this is true are supposed to continue customers of the railways during the long run.⁷ But the railways prevent many traders from having a long run. In the words of the Hepburn Commission, "in a speculative attempt to increase

where $K$ is the total cost of production. In order that the increment to Customers' Benefits may be positive, $-\frac{dK}{da} \frac{\partial P}{\partial y} - \frac{dK}{dy} \frac{\partial P}{\partial a} > 0$.

Whence (since $\frac{dK}{dy}$ and $\frac{dK}{da}$ are both negative) $\frac{\partial P}{\partial y}$ must be positive. That is, the production must be complementary (joint). Both prices cannot fall; since $\frac{dK}{da} < 0, \frac{dK}{dy} = 0,-a<0$.

¹ Principles, sixth ed., p. 486.
⁵ Hepburn Commission, p. 2694.
⁷ The inadequacy of this supposition is strikingly illustrated by Frank Norris's story Orestes. But the exploitation of Dyke and other customers of the grasping Railway involved an element of fraud not here contemplated—typical of common cheats rather than common carriers.
business they favour one shipper at the expense of another."  
A witness admits to having "acted as a fostering mother" to one 
customer but not so to another—"a small concern."  
"A railroad has the life and death of the manufacturer in his hands," 
as Professor Ripley has said; and in the United States it has 
exercised that power unscrupulously, has ruined some in order to 
build up others. The American railway manager has fostered 
or frozen-out manufacturers, has brought on or kept back cities 
at his arbitrary discretion, like the ruthless agent of transporta-
tion in the nether world who, discriminating between passengers 
across the Styx,

"Nunc has, nunc accipit iles, 
Ars aliena longe subestus accepit."  

It is tenable, indeed, that even in Monopoly, as certainly in 
Competition, laissez faire is less detrimental than at first sight 
appears. Thus, perhaps, Professor Hugo Meyer is right when 
he affirms that if railway managers had had a free hand to estab-
lish "basing points" in Australia, they would have brought about 
that very decentralisation which has been vainly aimed at by 
governmental regulation. Perhaps he has rightly described some 
evils attending unrestrained discrimination as but "growing 
pains."

Postponing the difficult questions just suggested, I have to 
add here one dark trait to the picture of dynamical discrimina-
tion. The immunity from vicarious suffering which was claimed 
on statical grounds is not equally tenable dynamically. Static-
ally, it may be unthinkable that because through traffic has 
become less profitable, therefore the profit of local traffic should 
be diminished by an alteration of rates. But dynamically, if 
the loss of immediate profit has disturbed the balance of present 
and future advantage, it is quite conceivable that local customers 
who were before spared for future development should now be 
sacrificed to present exigencies.

(7) \textit{Action of competition.—Several corrections of our provi-
sional conclusions are required by the incompleteness of our first 
principle—the prevalence of perfect and perfectly self-interested 
monopoly. Firstly, Monopoly is seldom perfect. In spite of agree-

\begin{footnotesize}
\begin{enumerate}
\item Report, p. 64.
\item \textit{Lect. cit.,} p. 63.
\item Report of the Industrial Commission, Vol. XIX.
\item "Quo discrimina," on what principle of discrimination, was the natural
inquiry of an intelligent visitor; and the answer left him pondering and pitying
the victims of discrimination under their hard, not to say unjust, fate (erat
iniquum).—\textit{Aeneid, Book VI.}
\item Regulation of Railway Rates, p. 201.
\item Above, p. 160.
\end{enumerate}
\end{footnotesize}
RAILWAY RATES

ments and consolidations, railways are apt to compete for the carriage of goods and persons, whether by the offer of lower rates or higher accommodation. Then there is the so-called "competition of markets." when the customers of different railways compete against each other in one and the same market. Each railway in order to preserve and increase its custom must moderate its charges for carriage to the common market; just as an intelligent trade union will not demand a rise of wages so great as to make the competition of the employers in a foreign market impossible. I must leave it to railway experts to evaluate the extent to which these kinds of competition are effective. My analysis resembles Mr. Aequith's Coal Bill in not having any figures inserted. It is safe to say with Professor Johnson, "The railways are only partial monopolies."

As some kinds of competition prevent railways from exploiting their customers, so another kind of competition tends to prevent railways from being exploited by Governments or customers acting in combination. This is the competition between different industries for the funds of investors. In virtue of this competition the profits of railways (and like industries) tend to be on a level with all the industries that are run by Companies. This is certainly an appropriate conception; but to what extent it excludes the conception of monopoly I do not feel competent to determine. Professor Tausig has assumed, provisionally at least, and for the sake of argument, that "a railroad's business is carried on under the circumstances of free competition." Mr. Harry Turner Newcomb may be mentioned as having expressed the conception with peculiar clearness. It must be admitted that a railway company is analogous to, or rather identical with, a capitalist seeking the most profitable investment. But it is to be remembered that the equation of profits which is deduced from this Ricardian principle is true only over "long periods." But there is reason to think that in concerns of such magnitude as railways the relatively "short period" is absolutely long. It is

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1 The degree of uniformity prevailing between American railways is well shown in the fifth chapter of Enoy Johnson's American Railway Transportation.
3 There is latterly much complaint that manufacturers, combined in the form of "trusts," impose hard terms on carriers.
4 It is hoped that the reader of these pages will throughout retain in his memory what was stated at the outset (Economio Journal, Vol. XXI, p. 349) that "railways" are here used as typical of the larger class of industries which have been described as "public works."
6 Railway Economics, pp. 76, 78 et passim.
safe to say with Mr. Maurice Clark, "In the case of railroads, whatever may be the ultimate tendencies, there is undoubtedly over long periods a wide divorcing, not only of unit price from unit cost, but also of total return from total cost." 1 During the continuance of that divorce the theory of monopoly which has been propounded is applicable.

To the extent to which the Ricardian conception of normal profits in the long run is appropriate, no exception can be taken to dicta above cited 2 purporting that a loss by a rate at one point tends to be recouped by a rise in rates at other points. This is, indeed, Ricardo's central doctrine that capitalists finding profits below the natural level back out of an industry in such wise that, supply being contracted, prices rise and the diminished numbers in the business thereby obtain adequate profits. How far this theory is from the facts of the railway business prudent periloera. It may be remarked that the doctrine of recoupment comes with more grace from an author like Mr. Pratt, 3 who demands independence for the railways, than from those who demand that railways should be regulated, as being monopolies, with respect to actions which presuppose competition. 4

The qualification of monopoly by competition is, as we have seen, not an unmixed advantage. Not only are certain benefits of discrimination likely to be impaired, but also certain immunities from the pressure 5 of raised cost. But these benefits may

1 Standards of Reasonableness. 2 Above, p. 180, et seq. 3 Loc. cit. 4 The dicta of the Interstate Commerce Commission in this matter of recoupment are not entirely, I think, defensible upon the grounds explained in Subsection 6, above.

* The immunities here ascribed to monopoly are of two kinds. Firstly, when the raised cost which we may designate as a tax is very small, it is probable that the monopolist will not raise the price at all, the gain, thereby obtainable not compensating for the trouble to himself and the disturbances to his market which the readjustment of price would occasion (op. cit. II. 350 and Rosencranc Journal, 1923, p. 435). Secondly, if he does raise the price to the point of maximum advantage, the rise will probably be less than what it would be in a regime of competition. For let the equation connecting x the amount demanded with p the price be $x = F(p)$. Then if a tax of $v$ per unit of commodity is imposed, we have for $\Delta p$ the consequent rise of price $\Delta p = \frac{\partial F(p)}{\partial p} \Delta p = v F''(p)$

$\Delta p = \frac{v F''(p)}{1 + \frac{v}{F'(p)}}$

In our ignorance of the sign of $F''(p)$, whether the demand-curve is concave or convex (while we know that $F'(p)$ is always negative), we are justified in assuming that $\Delta p$ is less than $v$, what it would have been in the regime of competition. Of course $\Delta p$ may be greater than $v$, as Cournot has pointed out.
well be insignificant in comparison with the advantage attending
the limitation of the monopolist's power to exploit his customers.
The reader may be assisted in apprehending the nature of the
limitation and the extent of the advantage by a reference to
another paper.1 The conceptions there introduced seem appro-
priate to the position of one who enjoys a monopolistic power
of discrimination, but is deterred from using it unreservedly by
the prospect of competition. He may be regarded as aiming at
his own maximum profit subject to the condition, that his cus-
tomers obtain a certain amount of benefit, namely, as much as,
or perhaps a little more than, his competitors may offer. From
this point of view we may discern more clearly than is usual the
transition from the bad sense of the phrase "charging what the
traffic will bear," to the good sense, sometimes awkwardly
enough described as "not charging what the traffic will not bear."
The entrepreneur in both cases discriminates prices and adjusts all
manner of complicated variables to the end of securing maximum
profit; but the maximum is in the one case absolute, and in the
other case subject to a condition which the variables must fulfil.
To secure this beneficial result a small levain of competition
will suffice; for a reason that has been already explained, and
that will be referred to again in connection with the following
second limitation of the abstract theory.

(7) Altruistic motives.—The second modification of the
originally assumed self-interested monopoly relates to the
adjective. "Here and there better motives than egoism rule,"
as Professor Cohn witnesses in the context of the passage which
we cited as affirming the prevalence of self-interest.2 So Pro-
fessors Johnson and Huebner, after defining the "main pur-
pose" of railway managers to be that which we have so far
assumed, added:—

"It would be as unjust as inaccurate to say that philanthropical
and social motives are not also influential." 3

More explicitly they observe:—

"The railway official . . . may no longer, nor does he, con-
sider himself merely as the officer of a private business corporation.
He realises that he holds a dual position as the servant of a
 corpora-
tion and as the manager of a public service." 4

To the same effect the vigorous railway-president, E. P.
Ripley, who certainly has not been influenced by any bias in
favour of governmental regulation:—

1 C. II. 497, et seq. As to the position of the partial monopolist, op. & ii. 97.
2 Above, p. 173.
3 Above, p. 173.
"It is needful... that railway managers shall see and frankly concede that they are quasi-public servants, owing a different and a higher duty to the public than almost any other business men." 1

When asked, in the course of his examination by the Interstate Commerce Commission, whether he would increase a discriminating rate to any extent, provided it were profitable, say by 200 per cent., he replied:

"The advance would be too great of itself. It would be too great a shock to my sense of propriety—a shock to my sense of justice." 2

Doubtless in the case of companies as of individuals, it is difficult to disentangle altruistic from egoistic motives. It is sufficiently accurate to say, with the wise Albert Einböck—

"Enlightened self-interest" [dictates the exercise of power]
"reasonably and in a spirit of liberality." 3

There is also to be noticed the regard for public opinion which comes to much the same practically as regard for public welfare. Among many symptoms may be mentioned the importance attached by railway men to the proportion between profits and capitalisation. Theoretically, a Railway Company is concerned to maximize the absolute amount of profits in the present (and future) without reference to the amount of capital invested in the past. Theoretically there is nothing paradoxical about President E. P. Ripley's trenchant dictum that the making of freight "has not, never did have, never ought to have any relation to the capitalization of railroads." 4 But the opinion of the public, and, accordingly, the practice of the railways, is different. 5

So far as altruistic motives act the doctrine of recoupment above noticed is less open to criticism. If a railway from motives of liberality has refrained from charging all that some parts of the traffic will bear, it is intelligible that when straitened at other points the Management should retract its liberality. As Mr. Prair says, "when a railway company gets an inadequate return from one department, it is much less likely to make generous concessions in another." 6

2 Report, 3000, p. 301.
4 Quoted with disapproval by the Interstate Commerce Commission Report, 3500, p. 349.
5 On this controversial topic Johnson and Hubbauer express themselves with their usual moderation.
6 For the context of the passage cited above.
The altruistic motive need not be strong in order to be effective. An "exiguum elinamen" from the direction of egoistic purpose may result in a considerable benefit to the customers. For by the theory of maxima a small decrement of profit from its maximum is apt to be attended with relatively large changes in variables connected therewith, in particular Customers' Benefit.\(^2\)

Other corrections besides the two main ones that have now been indicated are required to adapt the rigid outline of abstract theory to human life. But these may be deferred.

\(^1\) *Loccicita*, Book II. \(^2\) See ζ, p. 407 η and ζ, and Index, s.v. *Maximum*.