Francois Quesnay: A Reinterpretation 1. The Tableau Economique

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FRANÇOIS QUESNAY: A REINTERPRETATION
1. THE *TABLEAU ÉCONOMIQUE*

By W. A. ELTIS[1]

The class shall learn: 1° To know and understand the Tableau as it is . . . 2° After this, the assumptions will be changed . . . and they should be left to do the addition and work out the result themselves; this to be continued until they can work out each case easily, be it of growth or decline. 3° When they are at this stage, we should come to the problems, that is to say of arbitrary disturbances to distribution . . .

This completes that part of education of this type which is absolutely necessary and indispensable for all those who have received enough education to learn the four first rules of arithmetic; . . .—Victor de Riqueti, Marquis de Mirabeau, 1767.[2]

FRANÇOIS QUESNAY'S achievement is one of the most remarkable in the history of economics. He published his first article on an economic problem in 1756 when he was 62 years old, and in the following twelve years he produced a series of influential articles and successive versions of his famous *Tableau Économique*. He also became the centre of the first school of economists, the Physiocrats or Économistes of pre-revolutionary France. The Tableau has two multipliers, one of them almost Keynesian, and Leontief has said that he was following Quesnay when he constructed his input-output table of the United States economy in 1941.[3] Marx, who according to Schumpeter derived his fundamental conception of the economic process as a whole from Quesnay,[4] called it '. . . an extremely brilliant conception, incontestably the most brilliant for which political economy had up to then been responsible',[5] and in 1935 Schumpeter himself described Quesnay as one of the four greatest economists of all time.[6]

Born the son of a farmer, Quesnay first achieved distinction as a surgeon, becoming Secretary of the French Association of Surgeons, a member of the French Academy of Sciences, and a Fellow of the Royal Society of London. In addition he became one of four consultant doctors

[2] Georges Weulersse, *Les Manuscrits économiques de François Quesnay et du Marquis de Mirabeau aux Archives Nationales*, Paris, 1910, p. 96 (E). (E) after a page reference signifies that the responsibility for the translation is the present author's.

[3] Wassily W. Leontief, *The Structure of American Economy 1919–39*, Oxford University Press, New York, 1941, p. 9.

[4] Joseph A. Schumpeter, *Capitalism, Socialism and Democracy*, Allen and Unwin, London, 1943, p. 22.

[5] Karl Marx, *Theories of Surplus Value* (*Volume IV of Capital*), Lawrence and Wishart, London, 1961, vol. i, p. 344.

[6] See Paul A. Samuelson, 'Economists and the history of ideas', *American Economic Review*, vol. lii, Mar. 1962, pp. 3–4.

to King Louis XV, with an entresol at Versailles where he was also Madame de Pompadour's private physician.[1] His first economic publications were two articles, *Fermiers* (1756) and *Grains* (1757), which Diderot and D'Alembert published in the Encyclopedia, and these provide a more detailed account of the agriculture of the time than the work of any other great classical economist, and they set out the foundations of Quesnay's theory of the working of economies, and the policies needed to ensure France's recovery from expensive wars and rural depopulation. The first edition of the Tableau followed a year later, and this was gradually modified and refined until, in 1764, Quesnay's principal collaborator, Victor de Riqueti, Marquis de Mirabeau, was able to write in a Preface to *Philosophie rurale*, the book (written with Quesnay) which 'provides the most complete and authentic account of the Physiocratic system considered as a whole',[2] that he was providing all the propositions needed to form an exact and complete theory of the working of economies, and:

> The *Tableau Économique* is the first rule of arithmetic which has been invented to reduce elementary economic science to precise and exact calculations . . .
> Calculations are to economic science what bones are to the human body . . . economic science is deepened and extended by examination and reasoning, but without calculations it will always be an inexact science, confused and everywhere open to error and prejudice.[3]

By 1764 Quesnay had indeed evolved a complete model of the working of economies as Mirabeau claims, and this allowed the full *dynamic* effects of changes in, for instance, the productivity of the soil, taxation, and the propensities to consume food and manufactures to be estimated. However, subsequent writers who have attempted to reconstruct the model have faced considerable difficulties, for each version of the argument, read in isolation, contains assertions that have no clear logical basis, and apparent gaps in the argument, inconsistencies, and puzzling calculations. Almost all the problems are solved, however, and the apparent inconsistencies removed when Quesnay's published works are read as a whole (and most have still been published only in French), and in addition, the important books he wrote in collaboration with Mirabeau, in particular Part VI of *L'Ami des hommes*[4] entitled 'Tableau Économique avec ses Explications', and *Philosophie rurale*. Clearly only scholars with a particular interest in his work will go to this much trouble to understand

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[1] See Jacqueline Hecht, 'La Vie de François Quesnay', which is published in *François Quesnay et la Physiocratie*, Institut National d'Études Demographiques, Paris, 1958. This two-volume publication contains the most recent and complete edition of Quesnay's works, and it will be referred to subsequently as *Quesnay*.

[2] This is the view of Louis Saleron, the editor of *Quesnay* (see p. 687).

[3] *Philosophie rurale*, Amsterdam, 1764 (reprinted in 1972 by Scientia, Verlag Aalen), vol. i, pp. xl–xli (E). It is to be noted that there are two 1764 Amsterdam editions with different pagination. The first edition was published in 1763.

[4] *L'Ami des hommes*, Avignon, 1756–60 (reprinted by Scientia, Verlag Aalen in 1970).

him, but those like Schumpeter who persevered until they understood the model developed a great admiration for its originator.

In this and a following paper on François Quesnay's theory of economic growth, an attempt will be made to present a modern reconstruction of Quesnay's account of the working of economies. In the present paper an account will be given of the basic assumptions on which his analysis is based, and how these lead directly to the famous *Tableau Économique*. The successive versions of the Tableau will then be explained. In the paper that will follow on Quesnay's theory of economic growth, the effects of departures from the Tableau's equilibrium proportions will be shown. As in Marx's analysis, the scheme of simple reproduction depicted in the Tableau is merely the starting-point for the analysis of real problems, and any departure from the Tableau's exact equilibrium proportions must produce clearly analysable effects, including growth or decline in the economy's level of output and employment. The conditions which produce growth and decline will be systematically set out, and it will be shown that they are precisely those that Quesnay emphasized when he discussed real economies.

Quesnay's assumptions

In this part of the paper, Quesnay's basic assumptions about the factors which influence the development of economies will be outlined in turn. The first stage of the exposition is an account of his assumptions about techniques of production in agriculture and industry and their effectiveness, for this leads to the fundamental Physiocratic proposition that only agriculture produces a surplus or 'net product' over costs (where these arguably include a 'normal profit'), the size of the surplus depending on the capital intensity of agriculture. The second stage of the exposition which follows directly from this is an account of Quesnay's remarkable assumption that the economy's effective demand for marketable output depends on the expenditure of the agricultural surplus by landlords which has a multiplier effect on demand, and the further assumption that the relative size of the agricultural and industrial sectors of the economy depends upon how demand is distributed between them. The best known Physiocratic propositions all follow from these assumptions, i.e. that agriculture which alone produces a 'net product' must be the ultimate source of all tax revenue: that the economy cannot grow without agricultural growth: and that the industrial sector is wholly dependent on the agricultural, since the demand for manufactures depends on the size of the 'net product' which is wholly derived from agriculture.

The foundation of the whole system of thought is Quesnay's analysis of agricultural techniques of production which he first outlined in his

Encyclopedia articles of 1756 and 1757. There he distinguished three techniques of production: the cultivation of land with labour alone, cultivation with ox-drawn ploughs, and cultivation with horse-drawn ploughs.

Where labourers cannot find employment with a *métayer* using oxen or a farmer using horses:

. . . they leave the countryside, or else they are reduced to feeding themselves on oatmeal, barley, buckwheat, potatoes, and other cheap products which they grow themselves, and which they don't need to wait long to harvest. The cultivation of corn takes too much time and effort; they cannot wait two years for a crop.[1] Its cultivation is reserved for the farmer who can meet the expense, or the *métayer* who is helped by the landlord . . . [1756][2]

and:

When the peasant works the soil himself, it is evidence of his wretchedness and uselessness. Four horses cultivate more than a hundred *arpents* [125 acres]; four men cultivate less than eight. [1756][3]

and finally:

A poor man who only draws from the land by his labour produce of little value such as potatoes, buckwheat, chestnuts, etc., who feeds himself on them, who buys nothing and sells nothing, works only for himself: he lives in wretchedness, and he and the land he tills bring nothing to the state. [1757][4]

Thus, where farming must be undertaken without the capital of either a landlord or a rich farmer who employs others, there is no marketable agricultural surplus. The standard of living is so low that anything which reduces it further causes actual deaths through starvation,[5] and the peasant can pay no rent to the owner of the land. He thus makes no contribution to his landlord, the Church, or the State.

However, a surplus can be earned with the two alternative techniques, the cultivation of the land with ploughs drawn by either oxen or horses, and Quesnay makes a series of detailed comparisons between these techniques.[6] Before the economic differences are examined, there is an important institutional difference:

It is only wealthy farmers who can use horses to work the soil. A farmer who sets himself up with a four-horse plough must incur considerable expenditure before he obtains his first crop: for a year he works the land which he must sow with corn, and after he has sown he only reaps in the August of the following year: thus he waits almost two years for the fruits of his work and his outlay. He has incurred the expense of the horses and the other animals that he needs; he provides the seed

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[1] Quesnay assumes a system of crop rotation where the land is ploughed but left fallow in the year before it is sown with corn. This was widely used in the eighteenth century (see B. H. Slicher van Bath, *Agrarian History of Western Europe 500–1850*, Edward Arnold, 1963, pp. 59, 244–5).   [2] *Quesnay*, pp. 446–7 (E).   [3] *Quesnay*, p. 453 (E).
[4] *Quesnay*, p. 498 (E).   [5] See *Quesnay* [1757], p. 553·
[6] Cf. the much less detailed comparisons in Fitzherbert, *Booke of Husbandrye*, 1534, Folio 6, 'Whither is better a plow of horses, or a plow of oxen'.

corn for the ground, he feeds the horses, he pays for the wages and the food of the servants; and all these expenses he is obliged to advance for the first two years' cultivation of a four-horse-plough demesne are estimated to be 10 or 12 thousand livres: and 20 or 30 thousand livres in a farm large enough for two or three plough teams.[1]

In the provinces where there are no farmers able to obtain such establishments, the only way in which the landlords can get some produce from their land is to have it cultivated with oxen by peasants who give them half the crop. This type of cultivation calls for very little outlay on the part of the *métayer*; the landlord provides him with oxen and seed corn, and after their work the oxen feed on the pasture land; the total expenditure of the *métayer* comes down to the ploughing equipment and his outlay for food up to the first harvest, and the landlord is often obliged to advance even these expenses. [1756][2]

Thus farming with horse-drawn ploughs which Quesnay calls '*la grande culture*' is undertaken by entrepreneurial *farmers*, while ox-drawn ploughs are used by *métayers* and Quesnay calls this kind of farming '*la petite culture*'. Where entrepreneur farmers are not available, landlords cannot have their land cultivated with horse-drawn ploughs, for:

. . . they would not find *métayers* or ploughmen [*charretiers*] able to handle and supervise horses in these provinces. They would have to arrange for them to come from far away, which could involve considerable inconvenience, for if a qualified ploughman falls ill or retires, work ceases. Such events are highly damaging, especially in busy seasons: and besides the master is too dependent on his servants, whom he cannot easily replace when they wish to leave, or when they work badly. [1756][3]

This means that the availability of rich farmers is the crucial factor that determines which technique is used. As soon as *la grande culture* and *la petite culture* are compared in detail, it emerges that the use of ox-drawn ploughs has great disadvantages. First, many more oxen are needed:

The work of oxen is much slower than that of horses: besides the oxen spend a lot of time grazing on the pastures for their own food; that is why normally twelve oxen, and sometimes as many as eighteen are needed in a farm which can be worked by four horses. [1756][4]

These large numbers of oxen need to be fed:

These oxen eat up the hay from his meadows, and a large part of the land of his demesnes remains fallow for their pasture; thus his property is badly cultivated and almost worthless. [1756][5]

Moreover, the oxen will be used part of the time for the peasants' own profit:

. . . the *métayers* who share the crop with the owner keep the oxen entrusted to them busy as often as they can by pulling carts for their own profit, which is more in their interests than ploughing the land; thus they so neglect its cultivation that most of the land stands fallow if the landlord fails to pay attention . . . [1756][6]

[1] See *Quesnay*, p. 428 (E)   [2] *Quesnay*, p. 428 (E).   [3] *Quesnay*, p. 429 (E).
[4] *Quesnay*, p. 429 (E).   [5] *Quesnay*, p. 445 (E).   [6] *Quesnay*, p. 431 (E).

The land which the oxen need for pasture, and the land that is otherwise uncultivated can be very profitably stocked with other animals. Quesnay specifies herds of sheep, beef cattle, calves, pigs, and poultry, but he points out that these cannot be entrusted to *métayers*. A particularly important point here is the manure that is obtained from the herds that can be stocked when the horse-drawn plough technique is used by rich farmers: Quesnay suggests that this may almost double grain yields.[1] Moreover, with the assumptions of *la grande culture* a wide variety of products can be grown by the rich farmers on land that is not quite good enough for wheat farming, and these are outlined in *Grains*.[2]

Quesnay makes detailed comparisons between the profitability of *la petite culture* and *la grand culture* in the context of the France of the 1750s, costing horses, oxen, animal feeding stuffs, farm workers, etc., and making assumptions about soil yields with the various techniques, and the prices at which grains will be sold over an average of good and bad harvests. He summarizes his results as follows:

> It has been seen from the previous details that the cost of farming 30 million *arpents* of land with *la petite culture* is only 285 million [livres]; and that one would have to lay out 710 million to farm 30 million *arpents* with *la grande culture*; but in the first case the product is only 390 million [livres], and it would be 1,378 million in the second. Even greater outlays would produce still greater profits; the costs and men needed in addition with the best methods of cultivation for the purchase and management of farm animals bring in on their side a product which is scarcely less than that of the crops.[3] [1757]

With *la petite culture* the *net product* or the excess of output over the annual costs of agriculture is 390 *minus* 285 million livres, or 105 million livres, and the ratio of this to annual expenditure, one of the crucial ratios of the Physiocrats, is $\frac{105}{285}$ or 36 per cent. With *la grande culture* the *net product* is 1,378 *minus* 710 million livres, or 668 million livres, and 710 million livres of annual advances then yield a rate of return of $\frac{668}{710}$ or 93 per cent, which Quesnay later rounds up to 100 per cent, legitimately in view of the fact that not all the products of agriculture have been included in the actual calculations.

These are rates of return on what Quesnay calls the 'annual advances' or circulating capital—the equivalence is nearly exact—of agriculture, i.e. the investment in raw materials, wages, etc., that must be made each year to produce a harvest. Farmers must also provide 'original advances' or fixed capital, i.e. animals including horses in particular, ploughs, farm buildings, etc., which do not need to be paid for each year, but these depreciate, or need regular replacement and it is assumed that 'interest' at a rate of 10 per cent must be earned on the total capital of farmers to

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[1] *Quesnay*, pp. 430–1.   [2] *Quesnay*, p. 477.   [3] *Quesnay*, pp. 504–5 (E).

cover this.[1] In his later writings Quesnay assumes that the original advances of farmers are four or five times their annual advances with the methods of *la grande culture*[2] (no figure for *la petite culture* is given) and a rate of return on annual advances of 100 per cent will be 20 per cent on total farm capital if original advances or fixed capital are four times annual advances, so that total capital is five times annual advances. Similarly, the rate of return with *la petite culture* will be less than 36 per cent, and if original advances or fixed capital with this technique are twice annual advances, the rate of return on total capital will be about 12 per cent.

It will be evident that Quesnay attributes overwhelming importance to the agricultural technique of production. With no agricultural capital, grain farming is impossible, and the commercial yield of agriculture is zero, while the standard of living is barely sufficient to support life. With the low capital per acre ox-drawn-plough technique, agriculture yields a return over annual advances of between 30 and 40 per cent and a return on total capital of perhaps 12 per cent, while with the capital intensive horse-drawn-plough technique, agriculture can yield 100 per cent on annual advances and perhaps 20 per cent on total capital. With the assumptions of modern economics, the horse-drawn-plough technique which is superior at virtually all factor prices would rapidly drive *la petite culture* out of existence, but it must be remembered that the institutional factors which Quesnay enumerated prevent this. Thus, only rich farmers can use the techniques of *la grande culture*, so landlords must have recourse to *métayers* who will farm with the techniques of *la petite culture* if there are too few rich farmers. Moreover, in the absence of banks able to lend at moderate rates of interest, farmers cannot add significantly to their own capital by borrowing, so the supply of capital of the rich farmers is inelastic.

It is interesting to contrast Quesnay's very detailed assumptions about agricultural techniques with the propositions of his great successors. Thus Ricardo who believed that farm workers must generally produce high outputs on good land apparently thought that '. . . the adoption of

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[1] In addition to the annual and original advances of the farmers, landlords' advances (*avances foncières*) to make the land fit for farming are also needed. These are hardly ever mentioned by Quesnay himself, but they play a considerable part in the work of later Physiocratic writers; L'Abbé Baudeau in particular saw rent as partly a return on the *avances foncières* of the landlords (*Explication du Tableau Économique à Madame de ****, 1770, included in E. Daire's *Physiocrates* of 1846 which Otto Zeller, Osnabrück, reprinted in 1966, pp. 822–67).

[2] In the 'Explication du Tableau Économique' of 1759, annual advances are said to be 1,050 million livres and original advances 4,333 million livres (*Quesnay's Tableau Économique*, edited M. Kuczynski and R. L. Meek, Macmillan, 1972, 3rd edition (1759) pp. v and viii), while in the 'Analyse de la formule arithmétique du Tableau Économique' of 1766 original advances are said to be five times annual advances. (*Quesnay*, p. 795.)

spade husbandry, and the dismissal of the horses and oxen from the work of the farm' might reduce agricultural output by about one-tenth.[1] According to Quesnay this would entirely destroy any agricultural surplus, and reduce the farmers to penury. In his account of agriculture, it is capital and not labour or land that is of crucial importance:

> Inefficient cultivation however requires much work; but as the cultivator cannot meet the necessary expenses his work is unfruitful; he succumbs: and the stupid bourgeois attribute his bad results to idleness. They probably believe that all that is needed to make the land bear good crops is to work it and agitate it; there is general approval when a poor man who is unemployed is told 'go and work the land'. It is horses, oxen, and not men who should work the land. It is herds which should fertilize it; without these aids it scarcely repays the work of the cultivators. Don't people know besides that the land gives no payment in advance, that on the contrary it makes one wait a long time for the harvest? What then might be the fate of that poor man to whom they say 'go and work the land'? Can he till for his own account? Will he find work with the farmers if they are poor? The latter, powerless to meet the costs of good cultivation, in no state to pay the wages of servants and workers, cannot employ the peasants. The unfertilized and largely uncultivated land can only let them all languish in wretchedness. [1757][2]

And finally, even the farmer must not be regarded as one who obtains his income from work. This is not what is needed:

> We do not see the rich farmer here as a worker who tills the soil himself; he is an entrepreneur who manages his undertaking and makes it prosper through his intelligence and his wealth. Agriculture carried on by rich cultivators is an honest and lucrative profession, reserved for free men who are in a position to advance the considerable sums the cultivation of the land requires, and it employs the peasants and gives them a suitable and assured return for their work. [1757][3]

Thus capital in the hands of rich entrepreneurs who are willing to farm is the mainspring of an efficient agriculture, which will provide employment at good wages on the land. It is interesting in this context that Quesnay suggests that a rate of return of 100 per cent or more really is earned on annual agricultural advances in England where *la grande culture* predominates and there are sufficient rich entrepreneurs who are willing to farm. The contrast between England which has an efficient agriculture, and France which does not, is brought out several times.[4]

Quesnay assumes quite clearly that capital and entrepreneurs are the only factors of production that are needed to expand agricultural production, for he states quite specifically that the availability of land and labour is not a problem. So far as land is concerned, he writes:

> The cultivation of corn is very expensive; we have far more land than we need for it . . . [1757][5]

[1] David Ricardo, *Works and Correspondence*, edited P. Sraffa, Cambridge, 1951, vol. ii, pp. 237–8.   [2] *Quesnay*, p. 505 (E).   [3] *Quesnay*, p. 483 (E).
[4] See, for instance, Quesnay [1757], p. 479, Quesnay's *Tableau Économique*, 3rd edition (1759), p. 20 and Quesnay [1763], pp. 713–19 where it is argued that a rate of return of 150 per cent on annual agricultural advances is earned in England.
[5] *Quesnay*, p. 473 (E).

In the Kingdom there are 30 million *arpents* of cultivable land which are fallow, and the rest is poorly cultivated; because the production of grains does not repay the outlay. [1757][1]

and he quotes approvingly from De Plumart de Danguel:

If one travels through some of the provinces of France, one finds that not only does much of the land that could produce corn or nourish animals lie fallow, but that the cultivated lands do not produce anything approaching what they could, given their fertility; because the farmer lacks the means to bring them to their true value. [1757][2]

There are also numerous passages where Quesnay speaks of the rural devastation of whole provinces, and the depopulation that followed taxes that were unfavourable to agriculture. Clearly scarcity of land will not act as an obstacle to development, nor will the availability of labour. Quesnay follows Cantillon who wrote 'Men multiply like mice in a barn if they have unlimited means of subsistence . . .',[3] and it was very much his view that the growth of capital determined the growth of population. Thus:

It is however only with the help of wealth that an agricultural state can enrich itself more and more; *for an abundance of wealth contributes more than an abundance of men to the growth of wealth; but on the other hand the growth of wealth increases the number of men in all remunerative occupations.*[4] [1757]

It is therefore through the increase of wealth that a nation can achieve the greatest advances in wealth, population and power. It would then be in vain for it to try to increase the number of men without first setting out to increase wealth.[5] [1757]

Moreover

If the government diverts wealth from the source which reproduces it perpetually, it destroys wealth and men. [1757][6]

and more fully:

Men bereft of edible wealth could not live in a desert, they would perish there if they found no animals or other natural products to feed themselves on up to the time when by their labours they had forced the land to supply them with the products necessary to satisfy their needs continuously. Hence wealth is needed in advance to obtain in succession other wealth to live on, and to come to live in comfort which favours propagation. A Kingdom where revenues are growing attracts new inhabitants through the earnings it can procure for them; therefore the growth of wealth increases the population. [1757][7]

Hence lack of population would not be an obstacle to growth. With land also available, it is abundantly clear that Quesnay believed that the accumulation of agricultural capital was what was primarily necessary to produce growth of output and population.

[1] *Quesnay*, pp. 549–50 (E).   [2] *Quesnay*, p. 493 (E).
[3] R. Cantillon, *Essai sur la nature du commerce en général*, 1755 ed. and translated H. Higgs, London, 1931.   [4] *Quesnay*, p. 570 (E). The italics are Quesnay's.
[5] *Quesnay*, p. 571 (E).   [6] *Quesnay*, p. 542 (E).   [7] *Quesnay*, pp. 537–8 (E).

Quesnay gave a detailed account of his assumptions about how labour and capital had to be combined to produce food with the various techniques of production he described, but he was at no point so explicit about the sectors of the economy responsible for manufacturing, personal services, transport, commerce, and trade—which he called 'sterile'. The choice of the word 'sterile' to describe the sectors of the economy responsible for these activities proved unfortunate and many nineteenth- and twentieth-century economists concluded that Quesnay's and the Physiocrats' analyses of the working of economies need not be taken seriously because of the absurdity that they regarded manufacturing as sterile. However, if Quesnay's assumptions about manufacturing and commerce are followed carefully, and the word 'sterile' is put on one side until what he is saying becomes clear, it emerges that Quesnay's propositions are not very far from the analysis of the relationship between industrial costs and prices that subsequently became conventional. Thus in 1757 Quesnay gave the following account of the connection between industrial costs and prices:

> The works of manufacture demand from those who make them expenditures and costs which are equal to the value of the manufactured goods; . . .
> . . . the workman who makes a cloth buys the raw material and lays out the expenditure for his own needs while he is making it; the payment he receives when he sells it reimburses him what he has bought and his expenses; what he receives from his work is only the restitution of the expenses he has incurred, and it is by this restitution that he is able to continue to live by his work. The competition of workers who seek a similar return to live on limits the price of the work of manufacturing to this same return. [1757][1]

Thus competition ensures that the prices of manufactures are no more than the raw material and labour costs required to produce them. There is thus apparently no allowance for profits in the prices of manufactures. However, it is evident from Quesnay's work taken as a whole that the wages that manufacturers receive include something that is very close to the modern concept of a 'normal profit'. In 1763 he set out the incomes of all the workers of the economy in very great detail in Chapter 7 of *Philosophie rurale* which he contributed, and in manufacturing, commerce, etc., he assumed that there were 300,000 '*Gagistes supérieurs*' who earned an average of 2,000 livres each, and 1,800,000 '*Gagistes inférieurs*' or artisans who earned an average of 500 livres each.[2] The entrepreneurs in agriculture who farmed two four-horse-plough demesnes had an average income of just 1,200 livres, while servants and agricultural workers had incomes ranging from 125 to 500 livres a year.[3] Of the 1,200 livres that the farmer or agricultural entrepreneur received, 600 livres were for 'their subsistence and that of their family', while the whole 1,200 livres were

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[1] *Quesnay*, p. 583 (E).   [2] *Quesnay*, p. 712.   [3] *Quesnay*, pp. 702–3.

for 'the enterprise of working two demesnes', which included a return for 'the work and risks of his enterprise'.[1] Clearly the *Gagiste supérieur* in industry who received 2,000 livres also received a return for enterprise and risk, i.e. a return which is not so far from the concept of a 'normal profit'.[2] There is no specific reference to a return to an entrepreneur's own capital, i.e. to profits on capital, as part of this 'normal profit', but it is most reasonable to think of the excess of the entrepreneur's income over subsistence as a return to the entrepreneurial capital he has to supply, and a return to enterprise and risk taking, and several of the passages that have been quoted make it very clear that entrepreneurs had to provide a great deal of capital to earn the kind of incomes that have been set out. Unfortunately the position is not quite as clear as this because agricultural entrepreneurs also receive 'interest' to provide for the depreciation and replacement of their capital, and to provide a margin against contingencies. There is no reference at any point to similar provisions in industry (although in the detailed account of the income and capital of the economy in the 'Explication du Tableau Économique' of 1759, industry was assumed to require the same fixed and working capital in relation to output as agriculture[3]). Quesnay's failure to refer to 'interest' in industry is usually regarded as a simplifying assumption, and it is most natural to assume that the return to industrial entrepreneurs which is set so high in relation to subsistence includes a return to risk and enterprise, and sufficient income to make it worth while for industrial entrepreneurs to continue their activities, i.e. that it includes what is now regarded as a 'normal profit'—the return that must be earned if they are to maintain constant output.

A point that should be noted here is that industry resembles agriculture in that 'advances' are needed for production, and in the subsequent *Tableau Économique* these advances (principally raw materials which must be bought in advance) form half of industrial costs, so output is twice annual advances in both the 'productive' and the 'sterile' sectors. However, in agriculture this doubling of advances produces a surplus as

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[1] *Quesnay*, pp. 702–3 (E).

[2] It is interesting that Professor R. L. Meek has suggested that 'In particular, a number of the problems of interpretation which have subsequently arisen are cleared up in the seventh chapter [of *Philosophie rurale*] which seems to have been written largely by Quesnay himself and which has been unduly neglected by most modern interpreters' (*The Economics of Physiocracy*, Allen and Unwin, 1962, p. 278. This book is referred to subsequently as Meek).

[3] *Quesnay's Tableau Économique*, 3rd edition, pp. viii–ix. The annual advances of the 'sterile' sector are said to be 525 million livres, and the original advances for 'tools, machines, mills, forges, and other works, etc.' 2,000 million livres. This has led R. V. Eagly to reconstruct Quesnay's argument with a sterile sector that produces the fixed capital for *both* sectors ('A physiocratic model of dynamic equilibrium', *Journal of Political Economy*, vol. 77, Jan./Feb. 1969. See also his *The Structure of Classical Economic Theory*, Oxford University Press, 1974, Chapter 2).

substantial further costs are not incurred, while in industry further costs, mainly the wage costs of working up raw materials into manufactures, are incurred as production proceeds, so the fact that output is twice advances does not mean that a surplus is produced, and in formal terms a rate of return of zero is earned on the advances of the 'sterile' sector. With the present interpretation of Quesnay's argument, the 'normal profits' on these are included in the exceptional income of the *'Gagistes supérieurs'*, which is part of total wage and salary costs.

The fundamental assumptions which underlie the basic Physiocratic propositions that industry produces no surplus over costs while agriculture can produce a surplus if it is sufficiently capital intensive have now been outlined. The argument is basically that agriculture can earn something over and above costs (where these include a 'normal profit') while industry and commerce cannot. The extra earning power of agriculture is called its 'net product', and this is paid as rent or 'revenue' to the landlords. It is, however, basically a return on capital and not land, and it varies with the capital intensity of agriculture. The fundamental question arises of why 'labour and capital' can produce a surplus over wages and normal profits in agriculture and not in industry. Competition between entrepreneurs prevents the emergence of a surplus over costs in industry,[1] so an increase in industrial efficiency will eventually cheapen products and not produce a surplus for the producers. In contrast, an increase in agricultural efficiency supposedly increases the size of the agricultural net product or surplus. The fundamental assumption that allows Quesnay to arrive at this result, and it is also made by the great English classical economists, is that agricultural costs are largely fixed in terms of food. Thus the subsistence needs of farm labourers which determine what they are paid in the long run with an elastic supply of population are largely food,[2] and the farmer-entrepreneur gets a multiple of what labourers get. As the product of a farm is also food, an increase in agricultural efficiency, i.e. in food production per farm, must raise output relatively to agricultural costs (which can both be measured in food) and so increase profits which must go to someone. In stationary state conditions, Quesnay allows no more to the farmers than the multiple of the

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[1] Quesnay was naturally asked to explain the existence of large commercial fortunes, and specific cases where industrial output was sold at a high multiple of costs. For instance, in 1766 he discussed the problem of how ten manufacturers at Nîmes were able to make a profit of 150 per cent on costs by buying silk in Spain or Italy, and selling it as cloth in Germany (*Quesnay*, p. 759). His explanation is basically that if there were perfect competition [*concurrence libre*] this could not happen, and that the abnormal profit that arose as a result of its absence was earned at someone else's expense (*Quesnay*, pp. 771–80).

[2] See *Quesnay's Tableau Économique*, 3rd edition (1759), p. 10 (M). 'The daily wage of a labourer is fixed on the basis of the price of corn, and amounts to a twentieth of the price of one *setier*.' (The letter (M) after a page reference signifies that the translation is Professor R. L. Meek's.)

labourers' long-term subsistence needs that ensures constant output, and with growth farmers only receive more than this for a few years until leases come up for renewal, so what they receive is limited. There is no reference to the possibility that landlords might sometimes allow farmers to earn more, to attract tenants. Hence the bulk of any agricultural surplus must go to the owners of the land in the form of rents or 'revenue'— or indeed to the Church or the King. At a more fundamental level, it is the institutions of society—limitation of land ownership to the nobility, and property rights, which give the surplus to the landlords, even though land is not scarce. Voltaire's reaction to the role of the Sovereign in 1767 (and the hereditary landlords are similarly placed) goes to the root of the matter:

> It is quite certain that the land pays everything; what man is not convinced of this truth? But that one man should be the proprietor of all the land, that is a monstrous idea . . .[1]

This account of how agriculture can produce a 'net product' which is paid to the landlords, the Church and the State, while industry cannot, concludes the present account of what would now be called Quesnay's microeconomic assumptions. His macroeconomic analysis of how effective demand for agricultural and industrial output is determined, and how this influences the growth of the two sectors of the economy makes use of the propositions that have been arrived at.

The macroeconomic analysis of demand determination developed gradually. In his Encyclopedia articles of 1756–7 Quesnay makes it clear that the demand for manufactures and personal services, i.e. the demand for the products of the 'sterile' sector, and therefore for labour in manufactures and services, depends on the expenditure of the revenue or surplus of agriculture by the landlords who receive it. Thus:

> Industry procures subsistence for a multitude of men by paying for their workmanship; but it produces no revenue whatsoever and it can only be sustained by the revenue of the citizens who buy the works of the artisans. [1757][2]

> The works of agriculture make good their expenses, repay the costs of work, procure incomes for the workers; and in addition produce the revenues of the estates. Those who buy industrial goods pay for the costs, and the workmanship, and the merchant's return; but these goods produce no income beyond this.

> Thus all the expenditure on the works of industry only draws revenue from landed income; for works which do not generate revenue can only exist through the wealth of those who pay for them. [1757][3]

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[1] From a letter to Damilaville on 16 Oct. 1767 (see G. Weulersse, *Le Mouvement Physiocratique en France (de 1756 à 1770)*, Paris, 1910, vol. i, p. 147 (E)). Voltaire's common ground with the Physiocrats was limited as is evident from *L'Homme aux quarante écus*, which he published in the same year.

[2] *Quesnay*, p. 480 (E).   [3] *Quesnay*, p. 496 (E).

and moreover:

> The expenditure of these revenues constitutes the returns of the citizens who follow well paid professions. [1757][1]

As well as emphasizing the importance of the expenditure of the revenue, these passages make clear the full reasons for the total dependence of all other economic activities on agriculture, and therefore why Quesnay used the word 'sterile' to describe them. Not only does the production of industrial goods and services produce no surplus over 'normal profits', but in addition because demand depends on the expenditure of the surplus, the markets for the output of the remainder of the economy depend on expenditure flows which originate in agriculture. Moreover, the 'sterile' sector is dependent on the 'productive' sector for its raw materials. Agriculture in contrast is in no way dependent on the other sector.[2]

Quesnay's Encyclopedia articles show that as well as creating demand for manufactures and labour, the revenue is spent several times. Thus:

> The wealthy must be left free to spend. If affluence brings them to feed and pay for useless people, one must not place these domestic servants, it is true, in the ranks of men who play a part in the production of wealth; but one must at least see them as consumers who ensure the distribution of the money of the rich to all the well-paid professions; for the servants do not pile up wealth taken away from the circulation of the money that is destined to return continually to the source of annual wealth . . . It is with these servants as it is with the workmen engaged in making luxury articles for the nation's use: as these workmen are useful only in so far as they cause the rich to spend and as they spend themselves what they draw from their work. [1757][3]

The expenditure of rents or revenues is not merely necessary to produce demand for manufactures, services, and the lucrative professions, for it is clear from the above quotation that it is essential that there is sufficient expenditure that returns to 'the source of annual wealth', i.e. to agriculture. Thus again:

> A farmer has sold 100 *setiers* of corn for 1,600 livres. The landowner has received 1,600 livres for the rent of the land; he uses this sum to build; the workers to whom he has distributed it spend it on corn to feed themselves; thus the 1,600 livres returns to the farmer who sold them the corn. This farmer spends this sum on cultivation, to make more corn grow; thus the expenditure of the landlord becomes the returns of the workers, who restore to the farmer the sum that he has paid to the landlord. If this sum is taken away from the landlord, or from the workers, or from the farmer, its return in sequence is destroyed; the source will provide it no longer, neither to the landlord, nor to the workers, nor to the farmer. Its perpetual reproduction, the expenditure of the landlord, of the workers, of the farmer, are all suppressed; the corn which was the real wealth, which came into being again, and

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[1] *Quesnay*, p. 548 (E).

[2] H. Woog sets out Quesnay's reasons why industry is dependent on agriculture very clearly in *The Tableau Économique of François Quesnay*, A. Francke, A.G. Verlag, Bern, 1950, pp. 20–1.

[3] *Quesnay*, p. 568 (E).

which was consumed each year to feed the men is destroyed, and men must look elsewhere for their subsistence, and the State is impoverished and depopulated . . . [1757][1]

The maintenance of a continuing expenditure flow is crucial:

It is necessary that the owners of landed property who receive these revenues spend them each year so that this kind of wealth is distributed to the whole nation. Without this distribution the State could not subsist; if the landlords held back the revenues, it would be essential to despoil them of these; thus this type of wealth belongs as much to the state as to the landowners themselves; the latter only have the enjoyment of it so that they can spend it. [1757][2]

Productive expenditure	Expenditure of the revenue	Sterile expenditure
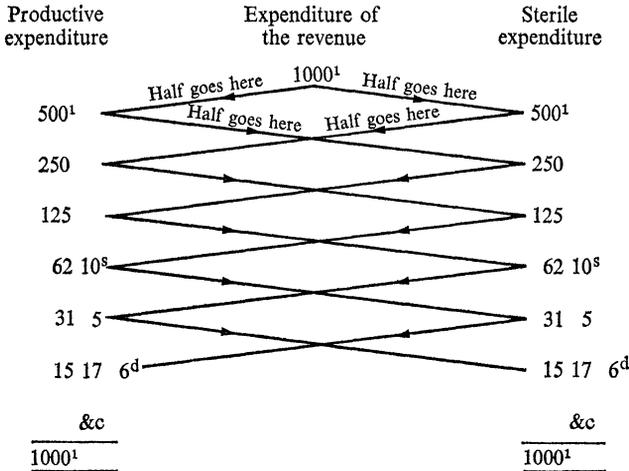
FIG. 1

(l. s. d. stands for livres, sous, and deniers; one livre = 20 sous, 1 sou = 12 deniers.)

These passages outline the position Quesnay had reached in 1757, namely that the expenditure of rents or revenues has an important influence on demand for the products of both industry and agriculture, and he may have owed much to Cantillon's account of the role that rents play in the circulation of demand.[3] A year later Quesnay set out the effect of the expenditure of rents formally for the first time in his first draft of the *Tableau Économique*, and this is illustrated in Fig. 1 which shows the circulation of the revenue as it is set out in the early editions of the Tableau of 1758–9, with the revenue changed to 1,000 livres. He assumed here that landlords, farmers, and artisans each spend half the money they receive on the outputs of the 'productive' sector, i.e. on the products provided by 'agriculture, grasslands, pastures, forests, mines, fishing, etc.', and the remaining half on the products of the 'sterile'

[1] *Quesnay*, pp. 541–2 (E).   [2] *Quesnay*, p. 582 (E).
[3] See R. Cantillon (op. cit.), (1755) Chapters XII–XVI. Quesnay knew the book, and quotes from it in *Grains* (*Quesnay* [1757] pp. 482–3).

sector, i.e. on 'manufactured commodities, house-room, clothing, interest on money, servants, commercial costs, foreign produce, etc.'[1] It is also assumed that the expenditure flows between the classes which are initiated by the expenditure of the 1,000 livres of revenue that the landlords receive continue until the productive and sterile sectors have each received 1,000 livres, as in Fig. 1. The expenditure of rents gives the productive and sterile sectors 500 livres each. Both sectors retain half of this until the end of the circulation process, supplying themselves with half their consumption needs from their own sector, and spend the remaining half of the 500 livres on the products of the other sector.[2] Both sectors therefore receive a further 250 livres from the other, and when this is spent, half on each side, they receive a further 125 livres each, and so on as in the diagram, until total expenditure is twice the original expenditure of the landlords. Quesnay underlined precisely this aspect of the expenditure flows of the Tableau in 1763 in Chapter 7 of *Philosophie rurale*:

> With the assumptions of the present Tableau in which the advances of the productive class give rise to 100 per cent of revenue, this revenue which is spent in the year passes in its entirety to the productive class, and in entirety to the sterile class through the reciprocal transfers between one class and the other . . .' [1763][3]

Thus a multiplier of *two* can be applied to the expenditure of rents, and the aggregate domestic *market* demand for the products of the two sectors will be exactly twice the initial expenditure of rents—where the three classes (landlords, productive workers, sterile workers) always spend half the money they receive on the products of each sector. They may divide their expenditure differently, and a progression is illustrated in Part VI of *L'Ami des hommes* which was published in 1760 where five-twelfths of all expenditures go to the productive and seven-twelfths to the sterile class. The revenue in the Tableau in question is 1,050 livres, and the zigzags then bring 915 livres in all to the productive and 1,146 livres to the sterile class, with the result that the expenditure multiplier is slightly less than two.[4] The money receipts of the two sectors can always be inferred precisely from (i) total rents or revenues, and (ii) the proportion of money receipts that each class spends on the output of the productive sector of the economy. The precise formulae are set out in Fig. 2, where total rents are R, and the proportion of all incomes that is spent on the productive side is q. The formulae set out in Fig. 2 produce the exact totals outlined in the 'Tableau Économique avec ses Explications' of 1760.[5]

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[1] *Quesnay's Tableau Économique*, 3rd edition, Explanation, p. i (M).
[2] What happens to the money that is retained until the end of the circulation process will become evident when the full Tableau is explained below.
[3] *Quesnay*, p. 699 (E).   [4] *L'Ami des hommes*, Part VI, p. 192.
[5] Fig. 2 is derived from Diagram (1.1) in Izum Hishiyama, 'The Tableau Économique of Quesnay—its analysis, construction, and application', *Kyoto University Economic Review*,

The exact results arrived at by Quesnay and Mirabeau clearly depend on the assumptions that all receipts will be spent at every stage of the circulation process, and that none of the revenue is lost overseas, and these are Quesnay's first assumptions in each edition of the Tableau of
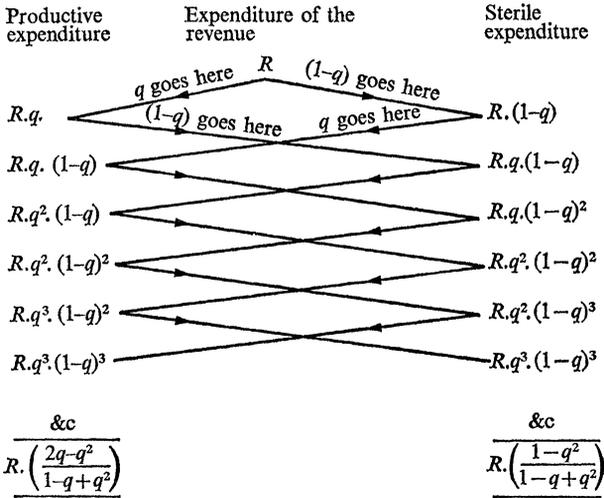
Fig. 2

1758–9. Thus, from the first printed edition where the total revenue is 600 million livres:

But in this distribution it is assumed:

1. That the whole of the 600 millions of revenue enters into the annual circulation, and runs through it to the full extent of its course; and that it is never formed into monetary fortunes, or at least that those which are formed are counterbalanced by those which come back into circulation; for otherwise these monetary fortunes would check the flow of a part of this annual revenue of the nation, and hold back the money stock or finance of the kingdom, to the detriment of the reproduction of the revenue and the well-being of the people.

2. That no part of the sum of revenue passes into the hands of foreign countries without return in money or commodities. [1758][1]

The assumption that the net product or rents of agriculture determine the effective demand for the marketed output of agriculture and industry is a most remarkable one, and it is unique to the Physiocrats. It has been suggested that Quesnay's previous published work on the circulation of the blood may have led him to believe that the circulation of money played

vol. xxx, Apr. 1960. The totals are derived in each case by summing two geometric progressions. The left-hand column, for instance, can be written as:

$$[(R.q+R.q^2(1-q)+R.q^3(1-q)^2...)+(R.q.(1-q)+R.q^2(1-q)^2+Rq^3(1-q)^3...)]$$

The formulae can be checked against the totals in *L'Ami des hommes*, Part VI, Tableau on p. 192. R. V. Eagly has also set out the multiplier effects of the circulation of the revenue very clearly (op. cit.).

[1] *Quesnay's Tableau Économique*, the Second Edition (1758), p. 3 (M).

a similar role in the working of economies, and that this led him towards the Tableau.[1] The circulation of the blood is referred to in a passage in *Philosophie rurale*, but this is in a part of the book that Quesnay commented on extensively rather than one that he wrote himself:

> Here it is necessary to observe that it is with this circulation of the money of the revenue as it is with the blood. It is necessary that all circulates without slackening, the least stoppage will produce a clot.[2]

The parallel between the circulation of money and of the blood is not, however, brought out in any passage clearly drafted by Quesnay himself.

The crucial assumptions on which Quesnay's analysis rests have now been outlined. It will be evident that his assumptions about the relationship between inputs and outputs in industry and agriculture, and about income distribution and the determination of effective demand for food and manufactures produce an account of the working of economies that is far from simple. Quesnay could doubtless have set out his argument in algebra (for his last book was concerned with mathematical problems) but he chose instead to use diagrammatic methods of exposition based on the *Tableau Économique* which he invented in 1758, and he later showed dynamic processes with a series of Tableaux which represented the economy in different years. Quesnay may well have believed that an argument based on the Tableau would be more widely accessible,[3] but the loss of clarity in not also providing an algebraic account made it immensely difficult for later generations (and indeed his own contemporaries) to grasp the argument fully.

In this paper, an attempt will be made to supplement Quesnay's diagrammatic exposition with an account of the basic interrelationships that underlie it.

Quesnay's *Tableau Économique*, and its explanation

Quesnay's basic Tableau of the early editions of 1758–9 is set out in Fig. 3, with Annual Agricultural Advances, the base of the Tableau, set at 1,000 livres. This Tableau incorporates the expenditure flows that were discussed in the earlier part of the paper, and in addition some of Quesnay's other important propositions. Perhaps the most important of these is the principle that agriculture (or the productive sector) can produce a surplus

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[1] See V. Foley, 'An origin of the Tableau Économique', *History of Political Economy*, Vol. 5, No. 1, Spring 1973.   [2] *Philosophie rurale*, vol. i, p. 66 (E).

[3] The following passage from 'Tableau Économique avec ses Explications' is interesting in this context: '. . . we have not claimed to make of it a work of Algebra, considered with all the relationships to which it is susceptible; that would be the amusement of a Geometer, useless to the aim of the Author, who has only presented in the Tableau the points of view that are indispensably necessary, and as it is, one will still find it only too complicated', *L'Ami des hommes*, Part VI, p. 129 (E).

or 'net product' of 100 per cent, while industry produces no surplus. This is firmly incorporated in the Tableau, for it will be noted that against each receipt of the productive sector in the left-hand column are the words 'reproduce net' followed by an identical sum of money printed in the

FIG. 3

column headed 'Annual revenue', so each 100 livres that the agriculturists receive from the year's expenditure flow reproduce and become 200 livres that can be disposed of in the following year. There is no extra column to the right of the 'Sterile expenditure' column, so 100 livres spent on manufactures produce only 100 livres at the foot of the table. As a result of this asymmetry between the 'Productive' and 'Sterile expenditure' columns the 1,000 livres of revenue that comes to the 'Productive' column generates a further 1,000 livre total in the central 'Revenue' column; while the 1,000 livres that goes to the right-hand 'Sterile expenditure' column produces a total of just 1,000 livres. The fact that the 1,000

livres that is spent on the products of agriculture becomes 2,000 livres shows that the land can produce enough to pay 1,000 livres to the landlords at the end of the year, and still retain 1,000 livres for the 'Annual advances' of the farmers, so that both the demand for food (which requires 1,000 livres of revenue) and its supply (which requires 1,000 livres of annual advances) can be maintained at the same level from year to year.

One point that is not clear from the Tableau alone is what happens to the economy's stock of money during the course of the year. This is 1,000 livres and the landlords hold it at the beginning of the year.[1] They then distribute it equally to each class, and the Tableau's zigzags continue its distribution, but it would be wrong to think that the sterile class will be left with half the stock of money at the end of the year. The sterile class consumes half of the 1,000 livres that it receives, and it uses the other 500 livres as advances for the following year (shown at the top of the 'Sterile expenditure' column), and these consist principally of raw materials which are bought from the agricultural sector for the next year's production.[2] The sterile sector will therefore exchange such money as reaches it in the course of the year for produce with the result that the economy's whole stock of money will reach the productive sector by the end of the year. Thus, at the end of the year, the productive sector is left, not with 2,000 livres of 'food', but with 1,000 livres worth of 'food', and 1,000 livres of money. The 1,000 livres of 'food' passes to the top of the 'Productive' column to become the productive sector's advances of the following year. The 1,000 livres of money passes to the top of the 'Revenue' column, i.e. the money is paid to the landlords, and this generates the following year's circulation or effective demand, while only 500 livres passes to the top of the 'Sterile expenditure' column to act as the advances of the sterile sector—for only the raw materials of the sterile sector actually remain in being from year to year.

The process can continue indefinitely if it is not disturbed. Each year 1,000 livres of annual advances in the productive sector in the form of food and raw materials, 1,000 livres of money in the hands of the landlords, and 500 livres of food and raw materials in the hands of artisans and merchants, become outputs of 2,000 livres of 'food' and 1,000 of manufactures; which are then marketed and leave precisely 1,000 livres of food

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[1] 'Thus the total money stock of an agricultural nation is only about equal to the net product or annual revenue of its landed property, for when it stands in this proportion it is more than sufficient for the nation's use', *Quesnay's Tableau Économique*, 3rd edition (1759), Maxims, p. 17 (M). See also Explanation, p. ix, and *L'Ami des hommes*, vi (1760), pp. 165 and 226.

[2] See p. 198 n. 1 below. Dr. Henri Woog (op. cit., pp. 72–83) has suggested that the sterile class holds its advances in the form of money, but this would make the money supply exceed total revenue, which would contradict Quesnay's several statements that it equals this.

and raw materials in the hands of the farmers, 1,000 livres of money in the hands of the landlords, and 500 livres of food and raw materials in the hands of the artisans and merchants at the end of the year. Quesnay's construction has been widely agreed to be a beautiful one, involving elegance, economy, and the several levels of meaning that characterize some of the eighteenth century's greatest works of art. The factors that may disturb the Tableau's equilibrium and so produce growth or decline will be discussed in the paper that follows this one, but it may be noted here that both of Quesnay's multipliers have the same value. Thus the equilibrium of the Tableau depends partly on the fact that a multiplier of *two* can be applied to the Revenue to ascertain its effect on aggregate market demand, and the same multiplier of *two* is applied to what agriculture receives because of the proposition that agricultural outputs are twice agricultural inputs. Thus the multiplier involved in the expenditure of the revenue is the same as the multiplier of the soil, for it is only in these conditions that each class will get back at the end of a year what it had at the beginning.

Successive generations have found the Tableau exceedingly difficult to understand, and some of the reasons for this will already be evident. Quesnay's achievement in showing monetary flows with his zigzags, and the production of goods on a single diagram is a remarkable one, but the fact that these are both shown makes the Tableau that much more difficult to comprehend. A second difficulty is that the Tableau shows only part of Quesnay's model. Thus the 'interest' costs of farmers and the receipts they need to meet these are not shown, and international trade is also left out—which matters, for consistency between the demand and supply of food and manufactures cannot be achieved in a closed economy. Only half the economy's consumer demand is for agricultural produce, but according to the Tableau, two-thirds of its output is agricultural. 'Food' must therefore be exported and manufactured goods imported, and Quesnay makes this clear in the 'Explication du Tableau Économique' that he published with the Tableau in 1759.[1] Finally the Tableau leaves a number of questions unanswered. Thus, it is not clear from the Tableau alone just what goes where in the process of consumption, for exactly how the agricultural output of 2,000 livres and the industrial output of 1,000 livres is divided between the classes is not shown on the diagram. Quesnay had to supply his 'Explanation' to show that the food and manufactures produced were exactly what was needed by the various classes, and for international trade. Clearly the Tableau cannot give a full account of the economy's activities without some further information and interpretation.

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[1] *Quesnay's Tableau Économique*, 3rd edition (1759), Explanation, p. iii.

The complete interactions of the Tableau depend on a number of fundamental equations that must hold when it is in equilibrium. First, the productive class and the sterile class must each receive just enough money from the Tableau's zigzags, etc., to meet their financial requirements. If they receive more money than they need, or less, their level of activity will rise or fall, so in the stationary state conditions that the Tableau describes, it is necessary that they receive exactly the right amount. In addition, there must be equality between the demand and supply of both

TABLE I

The solutions to the original version of the Tableau Économique

	Solution
Annual agricultural advances	A
Rate of return on agricultural advances	100%
Total rents or revenues	A
Wages and entrepreneurial incomes in agriculture	A
Interest of agricultural entrepreneurs	any value
Raw materials used in agriculture	any value
Exports of agricultural produce	$\frac{1}{4}A$
Raw materials used by industry	$\frac{1}{2}A$
Wages and entrepreneurial incomes in industry	$\frac{1}{2}A$
Gross industrial output	A

agricultural and industrial production if the Tableau is to be in equilibrium. The system of equations that determines the crucial values in the Tableau is completed with Quesnay's assumption that the costs of the industrial sector are half labour and half raw material costs,[1] and the further assumption that each class spends half its income on the agricultural and half on the industrial side of the Tableau. The equations that are produced by these conditions are outlined in the first section of the Appendix to this paper, 'A Mathematical Explanation of Quesnay's Tableau'. The equations are in fact very simple and straightforward, and the solutions that result with Quesnay's specific assumptions about propensities to consume, etc., are outlined in Table I above.

It will be seen that the solutions underline Quesnay's crucial argument that almost all the economy's quantities are multiples of annual agricultural advances, which are A in Table I. Thus total rents or revenues equal annual agricultural advances, wages in agriculture equal agricultural advances, wages in industry are one-half agricultural advances, and therefore half wages in agriculture, total industrial production equals agricultural advances, exports are one-quarter agricultural advances, and

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[1] See p. 198 n. 1 below.

so on. The capital of the entrepreneurial farmer therefore determines everything else as Quesnay argued in everything he wrote from 1756 onwards, and if this can be doubled, then so can all the other quantities in the economy, once this reaches equilibrium. As for the details of the solution, the first crucial one is that the rate of return on annual agricultural advances is 100 per cent, and this is what he was at such pains to show to be practicable, both because it was achieved in part of the French economy, and more to the point, because it was achieved in the whole English economy. With a rate of return on annual agricultural advances of 100 per cent, total rents or the economy's aggregate revenues equal agricultural advances, and this is the case in every edition of the Tableau.

The result that the raw material and interest costs of the agricultural entrepreneurs can take any value without disturbing the equilibrium of the Tableau is an interesting one. It is arrived at because the raw materials that are used in agriculture, and the horses, etc., that are bought to replace others with the 'interest' received are wholly supplied and used up within the same sector, so they must affect the costs and receipts of the agricultural class equally. This is not true of wages, rents, exports, and the agricultural raw materials that are used up in the industrial sector, and these must all be the precise proportions indicated in Table I.

The result that industrial wages are half agricultural advances and half agricultural wages is exactly what Quesnay states, for with agricultural advances and therefore wages of 600 livres in the printed editions of both 1758 and 1759, the wages of the sterile expenditure class are said to be 300 livres,[1] and in the economy as a whole it is said that there are 3 million workers' families (all quantities in the Tableau should be multiplied by a million to arrive at figures for the whole economy) which receive an average of 300 livres each, of whom 2 million are in the productive and one million in the sterile sector.[2] Finally, it is specifically said that exports of agricultural products are 150 livres (where agricultural advances are 600 livres), so exports are one-quarter of agricultural advances as in Table I.[3]

The fact that the results arrived at are precisely Quesnay's is a check that his fundamental argument has been followed. It also shows that it can be arrived at rigorously, and that his conclusions follow from his assumptions. He may either have followed the model through to the conclusions arrived at in Table I without publishing his actual reasoning, or he may have perceived intuitively that it all added up.

However he proceeded, he must also have appreciated that the Tableau as it is outlined in his diagram and in Table I can only take the argument

[1] *Quesnay's Tableau Économique,* 3rd edition (1759), Explanation, p. iii.
[2] Ibid., pp. iv–v.   [3] Ibid., p. iii.

so far. It presents a coherent account of an economy with one particular relationship between its various outputs and incomes: it is of course an economy in stationary state equilibrium, but the Tableau cannot be used to compare economies with different export ratios, or different rates of return on agricultural advances. This is because exports have to be one-quarter of annual agricultural advances and the rate of return 100 per cent in all economies that conform to the basic assumptions. Quesnay could not therefore use the Tableau to compare the French economy where advances yielded much less than 100 per cent with the English, so the Tableau was unsuitable for the kind of comparison that interested him most.

Quesnay and Mirabeau decided to deal with the problem by modifying some of the assumptions of the original Tableau so that an extra degree of freedom could be obtained. The crucial assumption they modified was the one that effective demand originates in the expenditure of the revenue, which is what limits the applicability of the Tableau because a very high revenue and therefore a very high rate of return on advances (i.e. one of 100 per cent) is needed to produce sufficient effective demand. The opportunity that Quesnay and Mirabeau took to give the argument extra freedom was the publication in 1763 of *Philosophie rurale* (its original title was to have been *Grand Tableau Économique*[1]) in which they planned to give a complete account of Quesnay's theory of the working of economies, and for this they needed a more flexible Tableau.[2]

They obtained this by inventing a Tableau which allowed the rate of return on annual agricultural advances to take any value whatsoever. The device they used to achieve this was the assumption that some agricultural incomes could be spent by rich farmers *as if they were rent*. Rich farmers could hold back some money after the harvest, and spend this for their consumption in the following year on the products of others, and this money would have the same effect on the circulation process as

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[1] G. Weulersse, *Le Mouvement Physiocratique en France*, vol. i, p. 86.

[2] It is highly probable that Quesnay was author and not just part-author of the passages in *Philosophie rurale* where the new Tableau is set up, and where sequences of Tableaux are used to show growth or decline when its equilibrium is disturbed. This can be inferred (i) because the passages in question are stylistically Quesnay and not Mirabeau, (ii) Quesnay wrote to Mirabeau of a passage he had drafted for *Philosophie rurale*, 'This spiritual chemistry demands more from the readers than arithmetical hieroglyphs, which displease you more than them' (Weulersse, *Les Manuscrits économiques de François Quesnay et du Marquis de Mirabeau*, p. 81 (E)), which clearly indicates that Quesnay may have taken more interest in the calculations than Mirabeau, and these are almost all based on the manipulation of Tableaux. Professor R. L. Meek has also drawn attention to Mirabeau's self-confessed dislike of calculation to attribute authorship of an important section of *Philosophie rurale* to Quesnay (Meek, p. 38). (iii) The author of '(Premier) problème économique' of 1766, and this is undoubtedly Quesnay, at several points describes increases in an unorthodox way: an increase of 20 per cent is described as an increase of one-sixth throughout the article. The identical unorthodoxy is to be found in an important passage containing sequences of Tableaux in *Philosophie rurale*. See vol. ii, pp. 184–5 and 188.

equivalent sums circulated by landlords. This is illustrated in Fig. 4 which is based on a similar diagram in the section of Chapter 9 of *Philosophie rurale* headed :

RULES

To form an abridgement of the Tableau in all the different cases where the advances of the productive class yield more or less than 100 *per cent of net product, and where it is supposed in addition that there are no causes of decline or growth in the annual reproduction.*[1]

```
Annual advances of                              Annual advances of
the productive class        Revenue             the sterile class
      1000¹                    200                     300
Of which is brought here       400
Leaving 600                    600
        300  ──────────────┐  ┌──────────────  300
                            ╲╱
                            ╱╲
        150  ──────────────┘  └──────────────  150
                            ╲
        75   ──────────────────────────────── 75

         &c                                      &c
        600                                      600
```
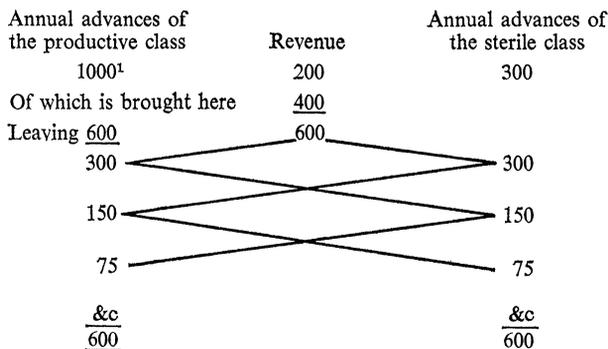
<center>Fig. 4</center>

In Fig. 4 the rate of return on the annual agricultural advances of 1,000 livres is only 20 per cent, and a revenue of 200 livres will provide a total market demand of only 400 livres which is much less than total production. However, if 400 livres of the agricultural advances of 1,000 livres are spent as if they are revenue, leaving 600 livres to be spent as wages, the total expenditure of 'revenue' (including 400 livres of agricultural advances) is 600 livres, while the agricultural advances that are spent as 'wages' are also 600 livres, and with industrial advances at 300 livres, the precise ratios of the original Tableau are obtained. This will be confirmed if Fig. 4 is compared with Fig. 3. The rule which must be followed to achieve this result is that equal total sums should be *spent* as agricultural advances and rent, and if poor landlords spend some of their income as if they are workers, and rich farmers some of theirs as if they are landlords, this can always be achieved. Quesnay and Mirabeau give several examples in the ninth chapter of *Philosophie rurale*.[2]

With the assumption that the expenditure of some advances as revenue (and vice versa) always maintains the correct rate of effective demand,

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[1] *Philosophie rurale*, vol. ii, p. 162 (E). Fig. 4 is based on the diagram on p. 175 of vol. ii.

[2] The theory clearly requires that where rates of return are substantially less than 100 per cent, there are sufficient 'rich' farmers who hold and spend money during the 'winter'. Otherwise the economy will contain regions where money hardly circulates, and monetization will be confined to the areas where landlords congregate and spend their revenues—these being insufficient to circulate money universally. This would limit the applicability of the Tableau in obvious ways.

Quesnay and Mirabeau were able to drop the Tableau's zigzags and set out a much simpler diagram, while they explained that the economy's money stock was circulating as before, and producing precisely the same results. They called the result a précis of the original Tableau, and the one equivalent to the Tableau set out above is shown in Fig. 5.

Productive class: agriculture, etc.	Revenue	Sterile class: industry, etc.
Advances 1000[1]	200	Advances 300
Producing 1200		Producing 600

	Demand	
100	Expenditure of revenue	100
500	Expenditure of wages of productive class	500
600	Expenditure by sterile class on agricultural products	
1200		600
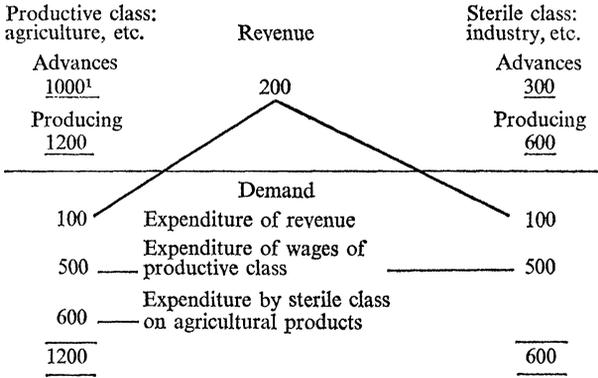
<div align="center">FIG. 5</div>

All that needs to be said here is that half the revenue of 200 livres goes to each side: half the wages of the productive class go to each side: and the entire 600 livres the sterile class receives from the other two then comes back to agriculture, half being spent on agricultural products for consumption, and half on raw materials for the next year's advances. The assumption that the sterile class spends all it receives on the agricultural side of the Tableau is an apparent departure from the propositions of the original Tableau of which more will be said below. A similar précis Tableau can be drawn at all rates of return on advances, and in each case demand from these sources will equal precisely what is produced on each side, as in Fig. 5.[1]

The précis of the Tableau in *Philosophie rurale* was modified further in Quesnay's final version of the Tableau which he published in 1766 as 'Analyse de la formule arithmétique du Tableau Économique'.[2] This is the version of the Tableau that Marx admired and discussed in 30 pages of his *Theories of Surplus Value*,[3] and it is the version that has been turned into an input-output Table.[4] The Tableau of 1766 is the Précis Tableau

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[1] The rule that must be followed to produce this result is to make the advances of the sterile sector one-quarter of the sum of annual agricultural advances and rents, as in the original Tableau. Only this makes the reproduction of the original Tableau possible. The rule is stated in *Philosophie rurale*, vol. i, p. 124, and again in vol. i, p. 328.

[2] *Quesnay*, pp. 793–812. It is translated in Meek, pp. 150–67 with one omission.

[3] Marx (op. cit.), vol. 1, pp. 308–44.

[4] A. Phillips, 'The Tableau Économique as a simplified Leontief model', *Quarterly Journal of Economics*, vol. lxix, Feb. 1955.

of *Philosophie rurale* with the single modification that the 'interest' costs of the agriculturists (which are assumed to equal 50 per cent of annual agricultural advances[1]) are directly included in the Tableau for the first time. The final version of the Tableau is outlined in Fig. 6, largely as

Annual advances of the productive class	Revenue for the proprietors of the land, the sovereign, and the tithe-owners	Advances of the sterile class

1000 million[1]   1000 million   500 million
producing   producing
2500 million   1000 million

Demand

500 million   Expenditure of revenue   500 million

500 million —— Expenditure of wages of productive class   500 million

500 million —— Expenditure by sterile class on raw materials

500 million —— Expenditure of wages of sterile class

500 million —— Expenditure of interest

2500 million   1000 million

of which one-half is held back by this class for the following year's advances

FIG. 6

Quesnay set it out with a rate of return on agricultural advances of 100 per cent but with some extra explanatory detail to help readers (and Quesnay's own text is printed underlined). Because of the inclusion of 'interest' at 50 per cent of advances, the annual agricultural advances of 1,000 livres produce a total agricultural product of 2,500 livres in place of the 2,000 livres of the original Tableau of 1758–9, and the extra 500 livres is used up because farmers spend their 'interest' on the agricultural side to replace horses, etc. The final version of the Tableau is set out in Fig. 6 on the assumption of a rate of return on advances of 100 per cent, but it can be set out similarly with any rate of return, and there are examples of this version of the Tableau with rates of return of less than 50 and of 150 per cent in subsequent published articles of Quesnay's.[2] It

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[1] It is presumably assumed that interest is earned to replace original advances which are five times annual advances in the 1766 version at a rate of 10 per cent per annum.

[2] See *Quesnay* (1766) p. 863 and (1767), p. 980.

is to be noted, however, that it is only where the rate of return is 100
per cent that there is the correct amount of revenue to carry through the
financial transactions indicated by the lines of the diagram.[1] At all other
rates of return, some farmers must spend like landlords, or vice versa as
in *Philosophie rurale*.

The final version of the Tableau, and the précis of the Tableau in
Philosophie rurale, both suffer from one serious weakness or omission:
there is no reference in them to the consumption of industrial products
by the sterile class, who are assumed to spend their wages exclusively on
agricultural products. There is thus an apparent asymmetry of a highly
implausible kind between the expenditure pattern of agricultural workers
who spend half their income on agricultural and half on industrial pro-
ducts, and industrial workers who spend their whole income on food.
Quesnay was far too subtle a thinker to have an asymmetry of this kind
in his *real* or underlying model, and what he published always contained
certain abstractions in the hope that this would make for easier compre-
hension.

One way of dealing with the difficulty is to examine the equations
which lie behind the final version of the Tableau. These are outlined in
the second section of the Appendix where the mathematical basis of the
Tableau is discussed, and they produce the solutions that are presented
in Table II.

TABLE II
The solutions to the final version of the Tableau Économique

	Solution
Annual agricultural advances	A
Rate of return on agricultural advances	r
Total rents or revenues	$A.r$
Wages and entrepreneurial incomes in agriculture	A
Interest of agricultural entrepreneurs	$\frac{1}{2}.A$
Raw materials used in agriculture	any value
Exports of agricultural produce	$\frac{1}{8}.A(1+r)$
Raw materials used by industry	$\frac{1}{4}.A(1+r)$
Wages and entrepreneurial incomes in industry	$\frac{1}{4}.A(1+r)$
Gross industrial output	$\frac{1}{2}.A(1+r)$

It will be evident that as in the original Tableau, all quantities are multiples
of annual agricultural advances, and moreover, here the rate of return on

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[1] There is a very extensive literature on the expenditure flows indicated on the diagram,
and the major controversies are very comprehensively outlined and discussed in Henri
Woog (op. cit.), pp. 38–72. However, the only explanation that will work where the rate
of return on annual agricultural advances differs from 100 per cent (and none of the ones
Dr. Woog refers to will) is the one set out in *Philosophie rurale*, so it must be assumed that
this also applies to the final version of the Tableau.

annual agricultural advances (r) can take the value that is appropriate to the economy in question. One of the most interesting conclusions that emerges from Table II is that Gross Industrial Output varies with both agricultural advances and the rate of return in agriculture—it is $\frac{1}{2}.A(1+r)$. Then an economy with a highly profitable agriculture will have a larger industrial sector than another with an equal agricultural wage bill but less efficiency on the land. These are among Quesnay's most basic propositions, and they are arrived at here as the result of a highly technical argument.[1]

Turning to the problem of the apparent asymmetry between the consumption patterns of agricultural and industrial workers which was remarked on above, Table II indicates that there is a solution to the problem. In this table, which is derived on the assumption that all classes have the same propensities to consume food and manufactures in Quesnay's underlying model, the discrepancy is removed because industrial workers export half the agricultural products they buy with their wages, and trade these for manufactures overseas. Their wages are $\frac{1}{4}.A(1+r)$, and if they export $\frac{1}{8}.A(1+r)$ of food and exchange this for manufactures, they will have the same proportion of food and manufactures in their own consumption as everyone else, and as Professor Meek who first discovered this solution points out, the precise manufactures they import could be consumed by anyone including the richest landlords. Exports of food of half of industrial wages and corresponding imports of manufactures will ensure that sufficient total manufactures will be available to allow each class to spend half of its income on food and half on industrial products.[2]

It can only be conjectured that this solution to the problem is part of Quesnay's underlying theory which he never published completely, but the ratio of trade to agricultural advances in Table II is the same as that

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[1] Smith might have carried the argument an interesting stage further and said that the *larger* industrial sector associated with a more efficient agriculture would also produce more efficiently because the division of labour could be further extended in industry; and this leads directly to the proposition that England should be more efficient in industry than France (given the greater profitability of its agriculture) in the conditions of 1766–76.

[2] See Meek, pp. 282–3. J. J. Spengler (in 'The Physiocrats and Say's Law of Markets', *Journal of Political Economy*, vol. liii, Sept.–Dec. 1945) following Baudeau's *Explication du Tableau Économique à Madame de **** of 1770 (op. cit.) suggests that the final Tableau understates the total output of the sterile class because it does not include the products that the sterile class produces for itself. Thus the total wages of the industrial class should equal $\frac{1}{2}.A.(1+r)$ and not the $\frac{1}{4}.A.(1+r)$ indicated in Table II. They can then spend $\frac{1}{4}.A.(1+r)$ on food for their own consumption as Quesnay says, and supply themselves with equivalent manufactures without needing to trade. However, the Baudeau–Spengler argument makes industrial wages twice the industrial sector's raw material costs, and it is clearly stated in each of Quesnay's accounts of the Tableau that wages are one-half and not two-thirds of the industrial sector's costs, so it is unlikely that their solution is the one he had in mind. Moreover, their solution makes industrial wages as great as agricultural wages where r is 100 per cent, and the industrial wage bill is substantially smaller than the agricultural wherever Quesnay refers to this relationship.

in the original Tableau if $r = 100$ per cent, i.e. one-quarter of these, and there are two indications that Quesnay may have intended the precise solution of Tables I and II to apply to his final Tableau. In Chapter 7 of *Philosophie rurale* (which contributes so much to the interpretation of his thought) he set out a fully itemized Tableau showing each branch of agriculture and the sterile sector separately, itemizing types of income in each branch, and arriving at equal totals for the output of agricultural products and purchases of these. In this Tableau which resembles modern National Income accounts, he includes the following item among the purchases of agricultural products:

The Sterile Class buys of these	For the advances of its works and the business of exporting: 1,437,066,667[1](1)

Now, if the formulae of Table II are applied to the itemized Tableau, exports plus the advances of the sterile class come to 1,470,750,000 livres,[2] which is exceedingly close to the 1,437,066,667 livres that Quesnay allows for these items. There are a number of small arithmetical errors in this detailed Tableau, and it contains some more complex relationships than the simplified Tableaux that have been outlined in this paper, which must produce substantial differences in some results. However, the fact that Quesnay's complete Tableau shows almost precisely the answer for exports plus industrial raw materials that is arrived at in Table II indicates that the solution suggested there may very well be the one he had in mind. This is supported by the further evidence of a statement in the '(Premier) Problème Économique' of 1766 (which is based on the final version of the Tableau) where Quesnay says: 'Foreign trade can be estimated at about one tenth of the total product [of agriculture] . . .'[3] in a situation where the rate of return on annual agricultural advances is 30 per cent. According to the solutions of Table II, the ratio of trade to agricultural output should be 9·03 per cent in these conditions.[4]

This completes the present account of Quesnay's *Tableau Économique*. The importance of the Tableau is that it sets out with great precision the conditions in which an economy will achieve continuous reproduction with a constant level of output in each sector. The conditions for stationary state equilibrium are, as Quesnay and later Marx appreciated, the

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[1] *Quesnay* (1763), p. 712 (E). Professor Meek drew attention to this item in Meek, p. 283.

[2] According to Table II, exports plus the advances of the sterile class, which equal exports plus its raw material purchases, total $\frac{3}{4}A.(1+r)$ or $\frac{3}{4} \times$ (Agricultural advances + Revenues.) In Chapter 7, annual agricultural advances total 1,921,000,000 livres, and Revenues total 2,001,000,000 livres (*Quesnay*, p. 710), so $\frac{3}{4} \times$ (Agricultural advances + Revenues) equals 1,470,750,000 livres.

[3] *Quesnay*, p. 866 (M).

[4] In Table II, the ratio of trade to agricultural output is $(1+r)/(12+8r)$, agricultural output totalling wages *plus* rents *plus* interest where the cost of agricultural raw materials used in agriculture is disregarded as in the case in question. This comes to 13/144 where r, the rate of return on advances, is 30 per cent.

starting-point for an analysis of the conditions where growth will be achieved. Clearly there will be growth or decline in aggregate output if the equilibrium of the Tableau is disturbed. That is why the precise conditions in which the Tableau is in equilibrium are of such importance, and why such care has been taken to ascertain exactly what those conditions are. They form the starting-point of Quesnay's theory of economic growth, which is the subject of the paper that will follow.

APPENDIX
A Mathematical Explanation of Quesnay's Tableau Économique

1. The Original Tableau of 1758–9

The best starting-point for an understanding of the equations that underlie the original Tableau is to work out the implications of the condition that in equilibrium the total output or supply of the productive or agricultural sector, Y_a, must equal D_a, the demand for food and raw materials. Similarly, the total output of the sterile or industrial sector, Y_i, must equal D_i, the demand for manufactures and services.

Y_a, the gross output of the agricultural sector, must be equivalent to the sum of the incomes earned in this sector plus raw materials used up in production. Thus if the raw materials, etc., used up in agriculture are M_a, the 'interest' costs of the agricultural entrepreneurs I, the wages and entrepreneurial incomes earned in agriculture W_a, and the net product, i.e. the total rents or revenues of the landlords are R:

$$Y_a \equiv M_a + I + W_a + R. \tag{1}$$

Similarly, Y_i, the gross output of the industrial sector will be equivalent to the sum of wages and entrepreneurial incomes in that sector, W_i, and the raw materials used up, M_i, so that:

$$Y_i \equiv M_i + W_i. \tag{2}$$

D_a, the demand for agricultural output, is made up of the demand for the raw materials for both sectors, $M_a + M_i$, the expenditure of 'interest', I (for the replacement of farm animals that die, etc., is always made good from the agricultural sector), that part of wages and rents that is spent on agricultural produce, $q.(W_a + W_i + R)$ where q is the propensity to consume the products of agriculture of all classes,[1] and T_a, the net export demand for food and raw materials—and it is assumed by Quesnay that agriculture is always a net exporter. Then:

$$D_a = M_a + M_i + I + q.(W_a + W_i + R) + T_a. \tag{3}$$

Similarly, D_i, the demand for manufactures and services is made up of the demand of workers and landlords who all spend a proportion, $(1-q)$, of their incomes on the products of the 'sterile' sector, so they will spend $(1-q).(W_a + W_i + R)$ on these. However, some manufactures come from abroad, and T_i, net imports of manufactures, must be subtracted from home demand to produce the demand for the output of the home country's industrial sector. Hence:

$$D_i = (1-q).(W_a + W_i + R) - T_i. \tag{4}$$

In equilibrium, Y_a will equal D_a so that:

$$M_i + T_a + q.W_i = (1-q).(W_a + R)$$

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[1] It is to be noted that Quesnay always assumes that workers and landlords have the same propensity to consume 'food'.

and Y_i will equal D_i so that:

$$M_i + T_i + q.W_i = (1-q).(W_a + R)$$

It will be seen that these equations are identical provided that T_a, net agricultural exports, equals T_i, net imports of manufactures. They are thus the same equation provided that trade is balanced as Quesnay always assumes. If T is written for both exports and imports, the equation becomes:

$$M_i + T + q.W_i = (1-q).(W_a + R). \qquad (5)$$

This is one of the fundamental equations on which the *Tableau Économique* is based. It will be noted that M_a and I, the raw material and 'interest' costs of the agricultural entrepreneurs, play no part in the equation, so any level of these is compatible with equality of supply and demand for food and manufactures.

The principal further condition that must be satisfied in the Tableau is that the money receipts of the farmers and artisans, which depend on the circulation of the revenue, must be just sufficient to meet their financial needs. This produces two further equations, one for each class.

The agricultural sector receives the expenditure flows that originate from the revenue, and the calculation in Fig. 2 on page 183 above shows that these amount to $R.[(2q-q^2)/(1-q+q^2)]$. In addition, the agricultural sector receives M_i from the sale of raw materials to the industrial sector for its advances.[1] It spends $(1-q).W_a$ on wage goods from the industrial sector in the course of the year, and at the end of the year it pays rent of R to the landlords. In equilibrium, what it receives must equal what it spends, so that:

$$R.\left(\frac{2q-q^2}{1-q+q^2}\right) + M_i = (1-q).W_a + R.$$

i.e. $$R.\left(\frac{3q-2q^2-1}{1-q+q^2}\right) = (1-q).W_a - M_i. \qquad (6)$$

Turning to the industrial sector, this receives $R.[(1-q^2)/(1-q+q^2)]$ from the Tableau's zigzags in Fig. 2, and it uses this to spend M_i on raw materials from the productive sector, T, on agricultural products for export,[2] and $q.W_i$ on agricultural products for the consumption of its workers. Hence, in equilibrium:

$$R.\left(\frac{1-q^2}{1-q+q^2}\right) = M_i + T + q.W_i. \qquad (7)$$

(6) and (7) provide two equations that must be satisfied, given the circular flows of the original version of the Tableau, and (5) is an equation that a Physiocratic economy must always satisfy. These three equations can be supplemented by a

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[1] Quesnay's precise assumption in his *Explication* to the 3rd edition of 1759 is: 'Circulation brings 600 livres to the sterile expenditure class, from which 300 livres have to be kept back for the *annual advances*, which leaves 300 livres for wages' (*Quesnay's Tableau Économique*, 3rd edition, p. iii (M)). It is evident from this that the sterile sector buys the next period's advances after the circulation of the revenue is completed. Moreover, in the above quotation, wage goods are distinguished from the advances of the sterile sector, so these must, strictly speaking, be raw materials—and this is Quesnay's precise assumption in the later versions of the Tableau (see *Quesnay* (1763), p. 712, and (1766) p. 795). He is not, however, consistent on this point in his explanation of the Tableau of 1759 where the advances of the sterile class are sometimes said to include subsistence goods and there is no specific statement about the amount it spends on raw materials, which can only be inferred from the above quotation.

[2] International trade is one of the activities of the sterile sector, so it buys the goods that are exported as one of its own inputs, and the economy's imports are sold together with its own products via the Tableau's zigzags.

fourth, because Quesnay states frequently through the various versions of the Tableau that the costs of the sterile sector are half wages and entrepreneurial incomes, and half raw materials, i.e.

$$M_i = W_i \qquad (8)$$

With this fourth equation, there are sufficient equations to express R, T, W_i, and M_i in terms of W_a and q; i.e.

$$R = W_a \cdot \left(\frac{1-q+q^2}{2q-q^2}\right) \qquad (9)$$

$$M_i = W_i = W_a \cdot \left(\frac{1-q-q^2+q^3}{2q-q^2}\right) \qquad (10)$$

$$T = W_a \cdot \left(\frac{q-q^3}{2-q}\right). \qquad (11)$$

These are the general relationships that must hold in a Tableau of Quesnay's type. He at no point set them out in general terms, but he simply outlined the particular solutions arrived at where $q = \frac{1}{2}$, which he assumes wherever the Tableau is in equilibrium. Before the very simple results arrived at in the particular case where $q = \frac{1}{2}$ are presented, something must be said about a further assumption of Quesnay's which does not influence the results, but only the way in which these are presented.

In his various expositions of the Tableau, Quesnay assumes that annual agricultural advances, A, equal or nearly equal W_a, total wages and entrepreneurial incomes in the productive sector of the economy. Where the Tableau is set out in very great detail in Chapter 7 of *Philosophie rurale*, annual agricultural advances at 1,921 million livres are close to the incomes of agricultural workers and entrepreneurs which total 2,180 million livres,[1] and everywhere else these totals are identical. Presumably the non-wage components of advances, and Quesnay mentions animal feeding stuffs in the *Explication* to the Tableau of 1759,[2] are just balanced by wages and entrepreneurial incomes which are not included in advances, and this allows Quesnay to assume that $W_a = A$.[3] With the simplifying assumption that annual agricultural advances equal labour costs, A can be substituted for W_a in (9), (10), and (11), and this allows the results to be presented as Quesnay actually presented them, so that where $q = \frac{1}{2}$, $R = A$, $M_i = W_i = \frac{1}{2} \cdot A$ and $T = \frac{1}{4} \cdot A$. The results are set out in this way in Table I on page 188. In addition, as rents are explained as a rate of return (of r) on annual agricultural advances in Quesnay's argument, $R = A \cdot r$, and r must then be 100 per cent where $R = A$.

2. The Final Version of the Tableau of 1766

There must be equality between the demand and supply of both food and manufactures when the final Tableau is in equilibrium, and if all classes have the same propensity to consume agricultural products (and it can be supposed that they do in Quesnay's underlying model), equation (5) must be satisfied as in the original Tableau. Moreover, equation (8) which states that the industrial wage bill equals the cost of industrial raw materials also definitely applies to the final Tableau.

However, because of the change in the circular flow assumption, the financial receipts of the two sectors are no longer derived directly from the zigzags originating

[1] *Quesnay* (1763), pp. 710–11.
[2] *Quesnay's Tableau Économique*, 3rd edition, p. iii.
[3] The actual level of expenditure on animal feeding stuffs and other agricultural raw materials, M_a, is of course irrelevant to the Tableau's interrelationships because these are wholly produced and consumed in the same sector. For this reason they do not enter the basic equations that determine the model and this can be in equilibrium with M_a at any level.

4520.2   P

from the Revenue. This means that equations (6) and (7) do not apply to this version. There is, however, an equation peculiar to the final version that replaces them. This is the proposition that the advances of the sterile sector must be one-quarter of the sum of annual agricultural advances and rents; and it was seen on pp. 191–2 above that this guarantees that the financial requirements of both sectors are always met. The equation that produces this result is written as:

$$M_i = \tfrac{1}{4}.A + \tfrac{1}{4}.R \tag{12}$$

and it replaces (6) and (7). Equations (5), (8), and (12) are sufficient to produce the results outlined in Table II on p. 194 where $q = \tfrac{1}{2}$, and these are written down on the presumption that $W_a = A$ and $R = A.r$.

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