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CONFRONTING THE LINEAR IMPERIALISM OF THE AUSTRIANS:  
LOWE'S CONTRIBUTION TO CAPITAL AND GROWTH THEORY.

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I: INTRODUCTION

The smoke has disappeared from the battlefields of the Cambridge Controversies on Capital Theory, but the reasons for the conflict have not evaporated, nor have textbook expositions of the Neo-Classical parables been radically altered. Those familiar with similar skirmishes are not surprised at this outcome. Certainly there are signs of some humility amongst certain supporters of Cambridge on the Charles, as reflected in their call for more tolerance towards non-neo-classical visions (Hicks, 1973 and Dixit 1977) but, in general, the battle-lines are still well delineated. Calls for 'a golden harmony in steady-state reconciliation' are premature, if not naive (Weintraub, 1978, 330). What is most needed is closer critical examination of the differences between the various camps.

Two issues, in particular, deserve special attention: the crucial importance of interdependencies and the level of aggregation used to analyze them -- issues which are much more important in a dynamic than a static situation; and, the fact that real world dynamics involve changing information and sequential decisions, as prices do not adjust instantaneously and expectations are ever changing. Both issues were discussed long before the latest flowering of debate. Those familiar with Institutionalists critics of Neo-Classical price theory are well aware of the long-standing debates on the second of these issues but the first is much more neglected. Contributions by those outside the neoclassical mainstream to the analysis of interdependencies which are a product, not of exchange relations, but of the physical structure of production, thus deserve special attention.

John (formerly J.R.) Hicks (1973), in a retrospective discussion of Austrian capital theory, in which he dissociates himself from the 'Production Function School, -- the American version of Neo-Classical Theory' and from key aspects of his "Value and Capital," admits that since the 1930's too little recognition has been given to the problems of dealing with fixed capital in an Austrian framework (*ibid.*, 193, n.8):

I wonder how far it is the case that the input-output network came into the consciousness of economists before the 1920s. I doubt if it is in Walras; I suspect that it does

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not emerge until people like Sraffa and Leontief began to work on Walras in the light of what they found in modern censuses of production.

Certainly the Classicals discussed the sequence nature of production: first came the production period, in which wages were advanced and the constituents of constant capital, raw materials and durable assets were utilized; to be followed by the exchange period, in which accumulation and the possibility of crisis arose. But most and Marx especially, were aware that analysis of fixed capital could not be treated as a one-way street, or 'linear', model of production.

In short, those twentieth century writers familiar with Quesnay's "Tableau Economique" and Marx's reproduction models did not have to suffer the tortuous, almost medievalist, capital theory debates of the 1930's, or the voluminous and polemical debates of our era, to reach the conclusion that the Austrian view of production is deficient.

The intellectual debts of Sraffa and Leontief to the Quesnay-Marx tradition are reasonably well-known, and on occasions even acknowledged. But the contributions of other non-Neo-classical capital theorists is far less recognized. Hicks (1973, 190), suggests that current controversies are largely previous controversies in new, more technocratic guises. In order for 'the modern controversy ... to be settled, its relation to the old is one of the things that will have to be understood.'

This paper takes up this a challenge, though with a special emphasis on Adolph Lowe's contribution. His life span incorporates the three great capital theory debates: that which coincided with the turn of this century, that of the 1930's, and that of the present era. His life-long campaign has been to keep alive the constructive aspects of the post-Keynesian vision but has also offered practical suggestions to policy-makers. He thus deserves much more recognition on both these counts.

Substantiation of these claims requires, as a minimum, first, a brief exegesis of attempts to deal analytically with fixed capital within the neo-classical tradition; second, a delineation of the alternative Quesnay-Marx 'circular' approach; third, an outline of the Kiel contribution to the capital debates of the 1930's; and, finally an analysis of Lowe's subsequent polishing of the earlier critique, which culminated in the 1976 appearance of his "The Path of Economic Growth".

## II: THE LINEAR MODEL OF THE AUSTRIANS

Before the 1870's there was little agreement about capital. The only common ground was that it was not, an original factor, like land, and that it was certainly an important aid to production. But how did it materialize? Was it stored up labour or what? The Physiocrats and A.R.J. Turgot (see Meek, 1962 and Groenewegen, 1971, 1977) made efforts to analyze it; to Ricardo fixed capital was basically previously expended labour; Marx developed these insights further. However, sophisticated discussion of fixed capital did not emerge until the existence of a machine tools industry was more apparent. Nevertheless, adherence to a labour theory of value did raise vital questions about capital, anticipating later discussion of input-output relationships and the role of time. Indeed the subsequent jettisoning of a labour theory of value by mainstream economics created problems for capital theory which are unresolved to our day.

In the English camp of the 'marginal revolution', W.S. Jevons, P.H. Wicksteed, and

even Marshall, were loath to offer a simple definition of capital. In fact appendix E of Marshall's "Principles of Economics" contains several definitions. Most importantly, Marshall was well aware of the difference between logical and historical time, of the problems inherent in measuring the value of capital, and of the need to explain the origin of fixed capital. Though modern neo-classical textbooks define capital as "produced means of production," it is important to emphasize that the founders of this tradition were far less dogmatic. Indeed, American economists such as J.B. Clark are primarily responsible for modern textbooks renditions. On the other side of the Atlantic, particularly at Cambridge, neo-classical theorists were more eclectic. Interestingly, this distinction still survives between the two Cambridges.

Meanwhile, on the Continent, Leon Walras provided a more sophisticated analysis of the interdependencies of exchange. To him factors of production are concrete items in existence at a moment of time, exhibiting remarkable versatility. Fixed capital is assumed to be composed of heterogeneous items. Yet, steelworks cannot produce bricks and buildings are very different from machine tools. Or, in more formal terms, Walras assumes that there is substitutability between factors of production on the supply side, thus neglecting to delineate and analyze the limits to such substitution. To commence analysis with the assumption that fixed capital is "given" offers little guidance of how and why economies change in historical time. The end result of this sort of analysis is the formulation of policy prescriptions which, by ignoring 'the structure of production', are at best incredibly naive.

Fixed capital is not a mere parameter but a changing stock of produced means of production, determined by an on-going, dynamic investment process. The process is endogenous, not exogenous. Once we acknowledge the production of commodities by means of commodities, and the role of a surplus of output in excess of the inputs required to produce that output, fixed capital must be considered a variable and not a parameter which is given. The addition of more parameters to explain production as well as exchange does not provide an adequate explanation of the origins of fixed capital.

It was left to the Austrians, led by von Boehm-Bawerk, to attempt a tighter analysis. Carl Merger provided three key foundations for Boehm-Bawerk: the idea that the size of the capital stock increases as the period of production lengthens; the claim that increases in this stock are limited by the fact that part of total output must be consumed, and by the preferences of economic actors for present rather than future consumption; and, a definition of capital as the goods not consumed during the production period. (See Hutchinson, 1962, 138-52).

Boehm-Bawerk's definition of capital changed from edition to edition of his key works and his discursive and verbose style adds to the difficulties involved in providing a potted version of his theories. His main goal was to offer a superior alternative to Classical and Marxian analyses. Basically, he inverted the whole reasoning process of his adversaries: whereas the Classicals set out to explain the relative value of the product in terms of its cost of production, Boehm-Bawerk tried to derive the value of the means of production from that of the final product. Despite his ingenuity, his analysis suffers the same Achilles Heel as does Walras! His one-way street, or linear view of the production process prevents him from providing an explanation of the origins of fixed capital. To see why this is so requires a brief excursion into the miasma of his 'period of production'.

To help the reader, the nub of what follows is this. The attempt to deal with fixed capital in a 'linear' model of production by utilizing the concept of the 'period of production' failed because of circular reasoning. Measurement both of inputs and outputs

and of the quantity of capital cannot be made in terms of physical units, but must also be made in terms of values. But this is not a problem of the measurement of capital, as Joan Robinson has repeatedly emphasized, but of the meaning of capital. It is its inability to deal analytically with fixed capital which led the Austrian one-way street model to a dead-end.

Boehm-Bawerk, in his extensive discussions of the theory of interest, presented a theory of production which stressed its roundabout nature. In the "Positive Theory of Capital" (1923 edition, 79-89), a sequel to "Capital and Interest" (1884), he suggested that man can utilize the two factors, Nature and Labour, in either of two ways. The first involves an immediate product from the combination of the two factors. The second necessitates the production of one good, which can be used to produce a final product more efficiently. By developing this approach he formulated a concept of the 'period of production'. The more roundabout the process of production, the longer the waiting period, but 'on the whole ... every lengthening of the roundabout process is accompanied by a further increase in the technical result', although 'as a rule ... in a smaller proportion'. Technical change, he predicted, would usually lengthen the roundabout process, although he was aware that some type of change could shorten the process. If the process is made more roundabout it involves a longer 'average period' of production, a greater number of intermediate products, and therefore a greater degree of capital investment. In Boehm-Bawerk's own words (Ibid, 89):

The extent of roundaboutness of a process is the period of time which elapses on the average between the expenditure of the original productive powers, labour and uses of land, as successively employed in any work, and the turning out of the finished consumption goods. Production is more or less capitalistic according to the average remoteness of the period at which the productive powers exerted during the process are paid.

Contrary to what is often claimed by modern Austrians, the roundabout approach to production theory did not originate with Boehm-Bawerk. In fact, it can be traced back to at least the work of Mountford Longford in the 1830's. (See Seligman, 1925, 64ff). Labour and Nature were the 'primary productive powers' in Boehm-Bawerk's model; 'capital' did not play an independent role. Yet capital played a dynamic role, even if it was not directly responsible for what is produced. Capital allows a more effective utilization of Labour and Nature and is defined as 'an aggregate of products destined, not for immediate consumption or use, but to serve as means of acquisition'. (Ibid., 59). It is 'stored-up valuable natural power ... the medium through which the two original productive powers exert their instrumentality'. If a community desires expansion of its capital stock, thereby adding to the productivity of the original factors, then it has to forgo consumption in order to compensate for depreciation of existing capital stock, as well as to produce net additions to that stock. (Ibid., 100-18, 124-5).

Just as Marx predicted that the organic composition of capital would continue to rise in the long run, Boehm-Bawerk equated future progress with increasing roundaboutness of production, which necessitated longer periods of production. Both prognostications were in keeping with the primary, most obvious, forms of technical change occurring in their respective environments. Boehm-Bawerk also noted that increases in productivity would produce larger 'surplus returns' but, in a later work, he showed his strong disagreement with the Marxian theory of distribution. The return a particular factor received had little to do with the 'social power' exerted by the individuals behind a factor, as the alternatives open to the employer and the worker are

very limited. If one group achieves advantages, corrective forces would come into play, as the other group seeks to restore the parity of power. If the pressure of increasing wages becomes too great, the extension of roundaboutness becomes restricted. (See Kuenne, 1971 and Spengler, 1972).

In brief, Boehm-Bawerk conceived capital to be the aggregate of intermediate products. Capital goods represent the intermediate form which the original factors Nature and Labour assume on their way to maturity as consumable commodities or services. No distinction is made between fixed and circulating capital; both types of capital are 'intermediate products'. Such an approach constitutes a linear view of the production process - as intermediate 'products' move steadily towards their final goal, consumption, down a strictly one-way path. A diagrammatic representation of this process could take the form of a system of concentric circles with all goods grouped according to their distance in time from the consumer. Each circle of the 'Ringschema' represents intermediate products, with the innermost circle being constantly renewed by original factors without the aid of intermediate products, and the outermost circle passes each year into consumption. Therefore Boehm-Bawerk's analytical schema is strictly a linear model which cannot deal with the circular aspects of production which the "Tableau Economique" and Marx's reproduction models emphasized.

The above is only a cursory summary of Boehm-Bawerk's theory of capital. To J.A. Schumpeter, 'the whole construction no doubt looks gaunt, not to say freakish', but he urges Boehm-Bawerk's critics to remember the unfinished, unpolished nature of his work and his 'technical disabilities'. (Ibid., 907-8). The real value of Boehm-Bawerk's contribution to capital theory lies in the debates that it has engendered. But before examining the 1930's debates in some detail, it is necessary to discuss the alternative 'circular' approach.<sup>1</sup>

### III: THE 'CIRCULAR' ALTERNATIVE AND 'DISPROPORTIONALITY SCHOOL'

Marx argued that capitalist economies are inherently unstable for four main reasons: the tendency of the rate of profit to fall; the tendency towards excessive investment; lack of effective demand to match the increases in output; and finally, the prevalence of disturbances in the equilibrium between the capital goods and consumer goods industries. Over the past century all four have been elaborated by various schools of Marxists and neo-Marxists. Marx has also been described as an underconsumptionist by both friends and foes. Certainly the "Communist Manifesto" and "Anti-Duhring" (both written with Engels) contain underconsumptionist statements but "Capital" has many passages which indicate Marx's extreme distaste for such a simplistic explanation of the trade cycle (Eg. "Capital", Vol. II, Chs. 20-21). The often cited passage (Ibid., Vol. III, Ch. 30) - 'The ultimate reason for all real crises always remains the poverty and restricted consumption of the masses as opposed to the drive of capitalist production to develop the productive forces as though only the absolute consuming power of society constituted their limit' -- is the basis of the efforts, made by commentators as diverse as Wesley Mitchell (1927, 8-9) and Paul Sweezy (1942) to tag him as an underconsumptionist.

Unfortunately this passage has obscured the most important of Marx's four main reasons for capitalist instability -- the problem of balance between capital and consumer goods industries, or the disproportionality problem. Marx's discussion of this problem is rather circuitous and lacking in concrete examples. In his "Theories of Surplus Value" (1969, II, 532) he notes "If production were proportionate, there would be no over-production ... Since, however, capitalist production can allow itself free rein only in certain spheres, under certain conditions; there could be no capitalist production at all if

it had to develop simultaneously and evenly in all spheres."

Marx's concern with disproportionality is inseparable from his opposition to Say's Law. Classical support for the idea that any act of production creates sufficient demand to enable the output to be purchased -- Say's Law -- led to the conclusion that there is a metaphysical equilibrium of buyers and sellers. Significantly, J.C.L. Sismondi went well beyond such a view: commodities are not just 'products' but products of capital. In his "Nouveaux Principes de l'Economie Politique," he argued that capitalists obtain an increase in value through production, not because the product of their enterprise yields more than the production costs, but because they do not pay the full production costs' because they give workers an 'insufficient usage' for their labour. Moreover, this increase in value, 'surplus-product', is the source of capital accumulation. Sismondi then raised what Marx termed the 'realization problem'. If the workers who have produced the surplus-product can only buy back that part of the product which corresponds to the usage for their labour, and if the capitalists themselves do not consume the entire surplus-product, how can all the surplus-product be sold? Sismondi thought this could only be achieved through export of commodities. (1970 reprint, I, Book 2).

Marx rejected Sismondi's pessimism and the optimism of the upholders of Say's Law. The constant extension of external and internal markets in fact creates markets for expanding output. But this cannot continue ad infinitum. Higher levels of capitalist activity exacerbate internal contradictions: Sismondi's 'spiral of capitalist development' will eventually ensure capitalism's collapse, for dialectical reasons (1969, 55-6). It is interesting to note that N. Bukharin uses a spiral diagram to depict expanded reproduction in his "The Economics of the Transformation Period," (1971 edition, 206).

More formal analysis of this problem by Marx culminated in the construction of the first fictional input-output table in the history of economics, complete with estimates of input coefficients and analysis of the different effects of increasing investment on capital and consumer goods respectively. This table is inspired by the Tableau Economique but is also a significant advance beyond it (Grundrisse, 1973, 441). This table and the chapters on reproduction in "Capital" Vol. II do not require underconsumptionist assumptions. Indeed, if Marx were a vulgar underconsumptionist, he would have surely used the reproduction models to delineate this problem. Unfortunately, this is a debate that cannot be pursued further in the context. (See Kuhne, 1979, Part III and Schneider, 1981.) Commentators who argue that Marx was an underconsumptionist include Luxemburg (1963), Robinson (1942 ch. 6), Bronfenbrenner (1965), Sweezy (1942) and Emmanuel (1972, ch. 3). Those disputing this proposition include: Bleaney (1976), Dobb (1940, ch. 4), Blaug (1962, ch. 7) and Sowell (1972, ch. 6). Schumpeter (1954, Part IV, ch. 8) and Howard and King (1975, ch. 6) who sensibly take an agnostic position. What is indisputable is that Marx was highly critical of the underconsumptionists of his day and rejected the policy implications of their analysis -- that a redistribution of income from profits and rents to wages would remove the basic contradiction of capitalist economies. In brief, Marx was interested in disproportionalities other than simply those of an 'effective demand' (this term was actually used by Luxemburg) variety.

The disproportionality and underconsumptionist questions were at the centre of the debate in the 1890's between Lenin and the Narodniks and also dominated the German Social Democratic economic debate into the 1930's. Because of a total misunderstanding of the purpose of Marx's reproduction schemas by many writers, those who stressed disproportionality were smeared with charges of 'revisionism'. For example, Luxemburg's strongest vituperation was reserved for those who played down underconsumption problems and stressed disproportionality. She believed that such writers were implying

that capitalism could be saved by reducing disproportionalities and that imperialism was unnecessary as a means of countering underconsumption (1963). Unfortunately, this style of argument permeates even modern discussions of these debates. Smith (1979) and Rosdolsky (1977) accuse those who took the reproduction models seriously as being closet equilibrium theorists. The first asserts that all the Soviet economists of the 1920's were 'bourgeois because they utilized the concept of simple reproduction, whilst the second groups Lenin, Tugan-Baranovsky and Bulgakov as all being 'predecessors of the neo-harmonic current in Marxist economics'.

Most commentators on these debates have assumed that the mere delineation of the conditions necessary for equilibrium growth meant that one believed that such growth would prevail. They thus failed to comprehend the message of the models -- that equilibrium growth is highly unlikely because of the complex proportions which would have to be established and maintained. This message was certainly not lost on early Soviet planners.

Adolph Lowe was among the few who had understood the purpose of the reproduction models and set out to elaborate on their insights. In particular, he develops Lenin's (1893) subdivision of the capital goods sector into two parts: one that produces the fixed-capital goods used in the capital goods sector, the other which produces the fixed-capital goods used in the consumer goods sector. Like Lenin, and other writers of that era who opposed underconsumptionist arguments, Lowe stresses the structure of production -- the technological relationships inherent in the production process. But he is far removed from being a mere sycophant of Lenin or a 'Billy Graham Marxis', despite these important and acknowledged intellectual debts.

#### IV: CONFRONTING THE LINEAR IMPERIALISM OF THE AUSTRIANS: THE KIEL CONTRIBUTION

With the impact of the Great Depression of the 1930s went an increased interest in the theory of capital and interest, in the hope of producing superior policies to help ameliorate economic fluctuations. This reexamination centred on two aspects of 'Austrian' capital theory: the possibility of extending the concept of 'period of production' into a theory of the trade cycle' and, whether the assumption of a stationary state upon which such capital theory rested, could be removed without serious damage to the theory.<sup>2</sup>

The 'Austrian model' of the structure of production, originally schematized by Boehm-Bawerk, made its impact on twentieth century economics in a variety of ways. Apart from its utilization by K. Wicksell,<sup>3</sup> it deeply influenced the later work of F.A. von Hayek and L. von Mises, and helped stimulate the 1930s capital debates. For example, F. von Hayek's "Prices and Production" (1931) contains a model in which production is depicted by means a triangular diagram. At the apex of the triangle original factors alone produce the first intermediate products. These products then move downwards through the triangle and gradually increase in value as successive applications of original factors are applied. The height of the triangle can therefore depict the absolute period of production, while the base indicates the quantity of original factors employed. The area of the triangle represents the total stock of 'intermediate products', of capital, in existence at any moment of time. Using this model, von Hayek was one of the most active defenders of the Austrian approach in the 1930s debates.

These 1930s debates were partly an extension of an important earlier debate between Boehm-Bawerk and J.B. Clark in the first decade of this century. The basic

point of contention in this earlier debate was the legitimacy of the 'investment period' theory of capital, even in a framework of static assumptions. However, the problems of trying to dynamize the approach were not the centre of the dispute. In arguing against the 'Austrian model', J.B. Clark in fact presented an alternative non-linear model of production, which possessed basic similarities with that contained in Marx's reproduction model. (Clark, 1899, 269-75 and 1924, chs. iv, v & x). The full potential of this device was not realized in Clark's hands as he confined its use to mere expository purposes; he did not develop it as a tool of analysis.

Boehm-Bawerk's assumption that all capital is circulating capital or subsistence advances to labour, which are a necessary corollary of the period of production concept was central to the 1930s debates. Critics pointed out that fixed capital must be acknowledged to exist, and when this is done the difficulty of returning to the dawn of time to calculate the various 'average periods' of outputs that become inputs is insurmountable. The other central issue revolved around possible correlations between the period of production, the 'roundaboutness' of production, and the quantity of capital. F.H. Knight argued that an increase in the quantity of capital does not imply more time consuming productive processes or more durable capital equipment but despite the implications this had for the consistency of Austrian capital theory, Knight's claim was not widely accepted. In fact, the key issues in this debate were much better delineated by those familiar with the alternative 'circular model' of production of Quesnay and Marx.

A group of critics of Austrian theory at Kiel University in Germany have not been given the credit they deserve. Adolph Lowe his student Fritz Burchardt head of the Institut fuer Weltwirtschaft und Seeverkehr, and Bernard Harms, administrative were among them. Others who achieved considerable reputations included Wasily Leontief, Gerhard Cohn, Jacob Marshak, and Hans Neisser.

The emergence of the 'Kiel circle', can only be appreciated in a general context of the development of German academic economics, which was still dominated by historicism and social reformers. The so-called 'Marginal Revolution' of the 1870s was yet to have great impact. Even by the outbreak of World War I it is difficult to find serious exponents of either a neo-classical or classical 'theory', helped change this picture: with their demand for answers to the inflation of the early 1920s, their need to provide theoretical arguments against crippling reparation payments, and with the growing debate about the pros and cons of nationalization. With the setting up of the Kiel Institut, theoretical research was given a special boost. In this historical environment it is little wonder that German economists were particularly interested in economic dynamics; the equilibrium of neo-classical economics was not relevant for the economy they were trying to stabilize. (For more details on German economics in this era see Kuschmann, 1933 and Schumpeter 1954, 154-6). The major research interest of the group was on the construction of a theoretical model of cyclical growth, based on the problems of world industrialization, but capable of serving as a basis for policy predictions. They found little assistance in the theory of value and distribution then prevailing in more 'orthodox' circles. Their attention was naturally directed back to classical and Marxian analyses, and to a critique of Schumpeter's work on economic development.

Kiel debate was greatly enlivened by what appears to be an interesting equivalent to Keynes's Political Economy group which was operating at Cambridge at the same time. The Kiel arrangement was begun by Harms as a kind of model parliament; at each meeting one of an inner elite of twelve members would choose a topic for debate. Lowe and Burchardt were dominant in the discussions; Lowe commanded a large and respectful

following from the senior students in the gallery and Burchardt acted as a kind of devil's advocate. The debating chamber was in a Krupp recreation home, formerly the Kaiser's Yacht Club and was shaped like the inside of a yacht. Prominent public servants were invited to lecture and then subjected to intensive student examination. The 'Kiel Club' appears to have been more open and democratic than its Cambridge counterpart and, according to participants, was apparently just as stimulating intellectually. In fact one participant described the prevailing atmosphere as a kind of 'quasi-Bloomsbury'. Some of these Kiel economists saw a key problem with Austrian capital theory. Its 'one-way street' view of production with its 'stages of production', some nearer and some more remote, in both technical sequence and in time, from the stage of the ultimate sale of the commodity to a consumer, leaves out a very key feature of modern production. We must acknowledge that every enterprise and industry stands at the confluence of many other streets down which inputs are supplied to them by other enterprises and industries, and other streets down which their output flows to serve as inputs, or eventually to be consumed.

Leontief's training in Marxian economics and his study of the first Soviet attempts at input-output analysis had clearly influenced his perception of this problem. His years at Kiel appear to have greatly assisted this perception. Certainly the works of Burchardt and Lowe were available to him. Karl Ballod's fascinating 1898 "State of the Future," which profoundly influenced early Soviet planners with its detailed input-output tables, also illustrates the wealth of inspiration that was available. This topic cannot be pursued further here but it is important to note that Leontief, Burchardt and Lowe were all confronting the linear imperialism of the Austrians. (Clark, 1974, discusses this question at length).

Working under Lowe's supervision, Burchardt set out to contrast the linear approach of the Austrians with the emphasis Marx placed on the circularity of the production process. Disputing the picture provided by Boehm-Bawerk of 'intermediate products' steadily moving down the strictly on way road of the process towards their final goal, consumption, Burchardt (1928 and 1931-32) argued that the reproduction and expansion of the stock of fixed capital goods in a state of full resource utilization cannot be explained by this approach. Simply tracing the technical process of production back to some original combination of natural resources and labour does not explain the reproduction of fixed capital. Such capital, though itself an output, can only be maintained and expanded with the assistance of a circular process in which fixed capital goods also act as inputs. Burchardt does not question the ability of Austrian analysis to deal with the problem of working capital. If on the highest stage a stock of fixed capital goods is added to the original inputs of labour and natural resources, the downward flow to the final stage of finished output does describe the structure of working capital. Nevertheless, the Austrian model must be supplemented with the Marxian schema of expanded reproduction which clearly illustrates the reproduction of fixed capital goods. Lowe (1931) presents a variation on this theme.

The Burchardt-Lowe critique was taken up by a variety of writers in the English language debate. For example, Ragnar Nurkse (1935) made major use of Burchardt's contrasts in his contribution to the attack on the Austrian linear model of production. His debt to Burchardt is acknowledged in a footnote, but to anyone familiar with Burchardt's work recognized that Nurkse's article is largely a re-statement of Burchardt's discussion of the superiority of the Marxian division of production into Department I and Department II over the linear model of production. By implication, it is also a strong argument for the superiority of the circular approach to capital theory over its Austrian counterpart. Nurkse does note however that this 'alternative' approach, 'although it might claim to be the common-sense view, has perhaps been unduly neglected' (Ibid.,

232).

Yet Marx and his followers are not even given a mention as the progenitors of this alternative view of the production process. Instead, in a footnote, Nurkse shows a lack of perception of the critique of Austrian theory when he argues that Marx's analysis would, in fact, fit quite well the triangular schema of von Hayek, because of Marx's view of labour 'as the source of all wealth' (Ibid., 238, n.1.). Thus Burchardt and Lowe's important contribution, based on a circular approach to production, is hidden by Nurkse, who then proceeds to give a detailed outline of the reproduction models, which are clearly recognizable by anyone vaguely familiar with Marx's original schema: For example, he concludes (Ibid., 243):

Department I must, naturally, be subject to sharp fluctuations if the accumulation of capital equipment does not proceed at a steady rate. Generally speaking, it seems that, with a few isolated exceptions, economists have paid too little attention in the past to the relation of economic progress to the business cycle.

In short, Nurkse does not develop the implications of his critique of the Austrian model of production, to a more far-reaching critique of neo-classical capital theory in general, which is the next logical step in his implicit attack on the 'period of production' used by Boehm-Bawerk.

A similar, equally limited position was reached by J. Marcus Fleming (1935) who built on Nurkse's article and, in particular, on Nurkse's summary of Burchardt's critique of the linear model of production. His depiction of the production process in the real world, as contrasted with the 'Austrian' picture, is worth noting, (Ibid., 13):

We may envisage the production process as a sort of rivers-system with little tributaries joining together to form great streams, while, at other points, streams split into subsidiaries. The streams can in very few cases be traced to their sources (where original factors alone are applied), but fed continuously by the services of original factors and depleted by consumption. Many sorts of interrelationships may exist between the streams.

- a) A stream may split up into subsidiaries which later rejoin.
- b) Subsidiaries of one stream may be tributaries of another.
- c) Two streams may mutually contribute to each other.
- d) One stream may send out a subsidiary to join itself at a higher point, while the main flow continues towards consumption.

This analogical picture of production contains a number of implicit criticisms of a linear one-way model of production. In the first two possibilities, there is no guarantee that offshoot streams of activity will rejoin the mainstream in the same period of time as the progression of the mainstream to the point of reunification takes. Thus how can this river system be described as proceeding in the one direction? Moreover, in the third and fourth possibilities it is most likely that a circular process is involved. In other words, it is possible that the production process is fed at one point by an input which is identical with what it puts out itself at a later point.

The great significance of this discussion of 'circular' models of production becomes clearer, and its affinity with the more modern capital theory debate becomes more

obvious, when we relate it more specifically to the period of production concept. As Marcus Fleming concludes, the acceptance of circularity as an important feature of the economic system 'impairs the adequacy with which the time structure of production can be expressed in terms of the Investment Distribution of original factors, even in static conditions'. He continues (Ibid., 16):

Suppose that circularity were carried to its logical extreme, and that processes existed in which no original factor input whatever occurred which were fed entirely from their own output. A perpetuum mobile would exist from which services or goods would emerge in a constant stream. This might be looked on as an original factor were it not that, by alternating the time structure of the process it might be made more or less capitalistic, and such alternatives would have an effect on the interest rate ... Strictly speaking, we cannot affirm that all the value of a product can be traced to the value of the original factors which have gone to its making, plus interest changes on the periods for which these have been invested.

Discussing the development of economics after 1870, Schumpeter (1954- 966-67), praises the development of Walrasian general equilibrium theory but notes an important hiatus:

But the nature of economic dynamics was not even clearly visualized -- some identified it with a historical theory of change or else with a theory that allows for trends; others with a theory of general interdependence as against partial analysis of sectional phenomena; still others with a theory of a modern as against the tradition-bound economy of the middle ages; and a few simply with the theory of small variations of economic quantities.

By the 1920's some interest had been shown in comparative statics, by N. Pantaleoni and F. Oppenheimer in particular, and G. Cassell (1932) had put forward his idea of balanced growth. But the confines of most theorizing were essentially static. Explicitly dynamic schemas or methodologies were lacking; there was a general failure to see the limitations of prevailing static schemas. Burchardt, Lowe and others interested in developing classical and Marxian dynamics were thus important exceptions to this general myopia.

#### V: THE CRITIQUE DEVELOPED : LOWE, LEONTIEF AND SRAFFA

The rise of Fascism in Germany forced many of the Kiel circle to flee. Burchardt went to Oxford, where he pursued statistical interests until his death in 1955; he did not develop further the issues in his capital theory articles. After holding the Chair of Economics at Frankfurt am Main for a short period, Lowe sought refuge at the University of Manchester until 1941 when he took up a Chair at the New School for Social Research in New York. His retirement in 1963 has been followed by a fruitful continuation of teaching and research, culminating in his "The Path of Economic Growth" (1976). The change in environment, and particularly language, reduced the potential intellectual impact of all the Kiel refugees. Anyone who has tried to teach in a second language can

appreciate this problem. Besides, twentieth century economics has displayed a strong Anglo-Saxon bias. Even more important was their different training and interests. This point is best made by looking more closely at Lowe's personal intellectual history.

Introduced to Marx's reproduction models by Franz Oppenheimer, Lowe was a serious student of Rosa Luxemburg's attempts to develop these insights in her "Accumulation of Capital." However, he was more optimistic than Luxemburg about the possibilities of steady growth, rejecting her underconsumptionist leanings, and believing that as long as prices were fixed by labour values, then such growth was possible. His undergraduate training did not include a very thorough grounding in neo-classical economics; Ricardo, Mill and Marx still dominated German economic teaching. With this training Lowe was sceptical of much neo-classical theory: Walras was 'just a skeleton', Marshall deserved serious study; whilst J.B. Clark, who did not use a "jelly" analogy for capital, appealed to Lowe's interest in structural aspects of production.

Despite his skepticism about much orthodox theorizing, Lowe did not reject theory per se. In an early article on trade cycle theory (1926) he expressed optimism about the possibility of explaining economic fluctuations because of the discernibility of the underlying endogenous economic process. In later publications, he grew increasingly pessimistic about the possibility of the theory orthodox economists use being a useful guide to determining this process. His major 1930's work, "Economics and Sociology" (1935), expressed a growing dissatisfaction with the neo-classical vision. Referring to the growing complexities of economic life he pronounced (*ibid.*, 76):

The ultimate result of all these transformations is the very opposite of the classical state of objective equilibrium; the deviations have become larger and longer-lasting, the readjustments slow and incomplete; the circular chain breaks periodically. Economic behavior has ceased to be the model of perfect social interaction.

The superior approach therefore involved a return to the circular flow emphasis of classical analysis, with the important assumption that the fixed general sequence of cyclical phases is, in fact, a more accurate representation of the circular flow, than the traditional 'equilibrium path'. The endogeneity of the economic process deserved special attention. Lowe's interest in Marx is clearly reflected in such a view.

In his more recent works, Lowe has developed this theme further. Economics, if it is to be considered a science, must be a science of production, he maintains. If the economist searches for patterns of 'repeatable dependence', then the technical relations by which nature is made to serve man deserve primary attention. To Lowe, economics is much more than just a study of choice (1965 and 1977). He is emphatic that what was valuable in the earlier approaches to growth was not so much the substance of their analysis, but the dynamic method which the leading Classical and Marxist scholars applied (1954, 132).

Lowe's work has received little recognition from commentators on the development of growth theory, or on twentieth century economics in general. For example, H.J. Bruton has cursorily acknowledged his uniqueness (1960, 241 n.) and he is occasionally given a footnote reference (Seligman, 1962, 753). G.C. Harcourt in his "Some Cambridge Controversies in the Theory of Capital" (1972, 131 n.) recommends an article on the Classical theory of economic growth (1954) to readers unfamiliar with the kind of starting points the post-Keynesians now utilize. Strangely, and sadly, other Cambridge (U.K.) figures have not added to Harcourt's recommendation, with the exception of

Maurice Dobb (1960).

Lowe's latest work, "The Path of Economic Growth" (1976) cannot be given anywhere near a satisfactory assessment in this context: some of its main themes are a continuation of the earlier Kiel work. The work is very much a product of Lowe's earlier enquiries into capital formation and growth. (See also Lowe, 1952 and 1955). He argues that the achievements of classical theory, 'analytical stringency within a framework that makes allowance for the forces of the environment' must be developed, if we are to make any confirmable generalizations about growth. To do this Lowe suggests (1976, 8):

... we should base our trust in prescriptive rather than descriptive analysis. In other words, even if we do not seem to be able to generalize about the actual course of growth processes ... we may yet succeed in contributing a theory and in building reality-oriented models that reveal the means suitable for the attainment of stipulated goals of secular evolution.

Most modern growth theory possesses two characteristics: it tries to predict actual courses of long term development on the basis of steady growth or equilibrium dynamics and over-simplified behavioural assumptions. These make direct empirical application of such theory rather limited which to Lowe, means such theory is of little help in explaining actual growth processes. Given that the actual tendencies of secular processes cannot be predicted, he instead examines the many variants of a disequilibrium path which growth processes pursue in response to such things as changes in labour supply, in natural resources, and in technology. Thus the conditions required to achieve balanced growth deserve special attention: Lowe, for example, examines the structural consequences of a fall in the rate of growth and the economic effects of recycling.

His degree of disaggregation deserves special note. Marx's two-sector schema is extended to a three-sector schema by the subdivision of the equipment goods sector into two subsectors -- one producing equipment to be applied in the production of consumer goods, the other producing equipment to be applied in the replacement and (in a growth situation) the expansion of the equipment operating in either equipment goods subsector. Because he is most concerned with macroeconomic issues that are independent of the peculiarities of individual units or even industries, the level of aggregation required is well beyond that of input-output analysis but, at the same time, more limited than that used in Keynesian models.

He believes that Leontief's work is too disaggregated for analytical purposes: 'Why use a shovel when a bull-dozer is available' (1956, 586). Two main reasons are offered, if one's disaggregation is too great it is impossible to trace analytically the path of too many variables, especially if the numerous variables are exposed to several stimuli simultaneously. Moreover, and more importantly, all subdivisions of the productive structure are not equally important for the study of particular dynamic processes -- we need different levels of aggregation for different analytical problems. In other words, we cannot work on the a priori assumption that the theoretical problems involved in analyzing the destruction or building-up of the stock of fixed capital, the capital/output ratios, and capital widening and deepening, are the same in every industry.

Lowe's level of aggregation is thus a kind of half-way house between Marx and Leontief. Marx must be modified for three basic reasons: his structural analysis confuses stocks and flows, (as Joan Robinson has also emphasized) and appropriate stock variables must be added; Marx's two sector model focuses upon fixed capital only, so to

deal with working capital as goods in process, the capital and consumer goods sectors must be disaggregated into 'vertical' stages depicting the process by which natural resources are technically transferred into capital or consumer goods; and finally, it is vital to further disaggregate the capital goods sector into one sub group which produces the equipment to make consumer goods and another sub group which produces the equipment to make the equipment for both sub groups of the equipment goods group. Such a level of analysis draws greater attention to such key issues as limitations to the mobility of inputs and the problem of other factor supplies adequately adjusting to the demands of technological change. Lowe is not concerned primarily with the same issues as Harrod-Domar, Hicks and Goodwin -- with demonstrating that the growth process is likely to proceed in an unstable manner. He is more concerned with the fact that in a growing economy the pattern of demand will never be in equilibrium with the changing pattern of technological interdependencies.

This three sector schema, which he supplements with a multi-stage schema for some of his analysis, enables him to deal with production problems that require a model with both a 'value dimension' (of income-expenditure flows and asset stocks) and 'physical dimension' of technically differentiated inputs and outputs. (1976, 22-3). Clearly, by using such a framework, Lowe is illustrating the utility of an approach that was first outlined in more primitive form in Marx's reproduction models and which is drastically different from the linear models of the Austrians. The reader is referred to E.J. Nell's mathematical appendix to "The Path of Economic Growth" in which further similarities and differences between Lowe's model and the work of Hicks, Morishima, Robinson and Sraffa are investigated in a more formal manner. But the distinctive feature of Lowe's work rests on the inspiration he received from the circularity of the reproduction models.

Apart from the Burchardt-Lowe campaign, and some other contributions to the 1930's debates, the linear imperialism of the Austrians -- the term is Lowe's -- remained largely unchallenged until Sraffa's direct assault and, in fact, total rejection of linear processes of production in his "Production of Commodities by Means of Commodities" (1960). Sraffa's demonstration that fixed capital cannot be reduced to dated labour echoes misgivings raised in the 1930s debates by Lowe and Burchardt about the problem of fixed capital. In his discussion of 'reduction to dated quantities of labor', Sraffa (1960, 38) provides a proof of the impossibility of aggregating the (production) periods belonging to the several quantities of labour into a single magnitude which is then regarded as representing the quantity of capital. In other words, he demolishes the Austrian concept of an 'average period of production', which had been devised to measure the capital intensity of production techniques, independently of distribution. A marginalist theory of capital, he implies, cannot be constructed on such shaky foundations.

Sraffa argues that reduction to dated labour shows the labour component of a commodity, given the current technical conditions, wage rate and rate of profits. He then compares the 'dated' labour components of the same commodity at different rates of profits, and the labour components of different commodities at the same rates of profits. Thus, Sraffa argues that even if capital could be reduced to dated labour, back to infinity, there is no such thing as a quantity of capital which is independent of the rate of profit. Nell (1975) provides a clear discussion of the implications for distribution theory if the structure of production is made much more explicit than is usual in the neo-classical tradition.

R.F. Harrod's (1961) otherwise lack-lustre review of "Production of Commodities by Means of Commodities" at least raised this issue. His attempt to defend the 'average period of production', on the ground that it can be computed for any given rate of profits, was stillborn. Sraffa pointed out, in his reply to Harrod (1962), that even if computed the

average period of production could no longer be used to explain income distribution, because it remains vitally dependent on the profit rate.

The earlier capital controversies, with their attention on the period of production, clearly raised the problems of 'reduction to dated labour' and the origins of fixed capital. Indeed Sraffa acknowledges his inspiration to them, albeit indirectly (1960, 38):

the reduction to dated labour terms has some bearing on the attempts that have been made to find in the 'period of production' an independent measure of the quantity of capital which can be used, without arguing in a circle, for the determination of prices and of shared in distribution.

To Sraffa 'joint-production' is the dominant form of production, and since 'reduction to dated labour' is impossible, he replaces this approach with his theory of price formation based on the production of commodities by commodities. To do this he assumes that a plant not only produces output but also replacement fixed capital, within the time span of his 'year'. What Sraffa has done is add to the Burchardt-Lowe critique: to force more widespread recognition of the importance of a 'circular' approach to capital theory.

Paul Samuelson, summing up in the aftermath of the most heated battle of the 1960's capital theory debates, concluded (1966, 568):

If all this causes headaches for those nostalgic for the old time parables of neo-classical writing, we must remind ourselves that scholars are not born to live an easy existence. We must respect and appraise the facts of life.

The model developed by Lowe and Burchardt does show more respect for the 'facts of life'. Their model was not only available in the 1930s but was the basis of the most destructive critique of the Austrian approach. They merit much more recognition than has been accorded them in discussions of precursorial aspects of the current 'Cambridge Controversies'.

## VI. CONCLUSIONS

Adolph Lowe's contribution to debate over the methodology of economics is well acknowledged. (See, for example, Heilbroner, ed., 1969). But his precursorial role in the development of modern non neo-classical capital and growth theory is yet to be adequately recognized, though he is not the only writer to emphasize technical aspects of the production process. For example, and most interestingly, Lowe's general message has some affinities with the conclusions of A.G.B. Fisher's famous article (1933, 389):

That there is an intimate, organic connection between the processes of production and the processes of consumption, is, of course, obvious, if not commonplace. But the practical consequences of this organic relationship are seldom sufficiently considered or understood. As productive efficiency increases, it is inevitable, if the demands of consumers are to remain the controlling power, that the character of the goods produced will change at the same time. And with the change in the character of production the distribution of labour among

various types of work and the character of capital demand are certain also to change. Most people today agree that recovery from the depression is delayed by the stiffnesses and rigidities of certain parts of our economic organization; among these stiffnesses and rigidities it is desirable that much more attention should be given to the general reluctance to admit that changes in the character of production are likely to cause change in the relative importance of capital as a factor of production, and are certain to cause changes in the relative importance of the demand for capital forthcoming from different types of industry. Recovery from the depression is delayed by the general insistence that capital should be directed into the same channels as in the past. The progress of knowledge has made it desirable to change the relative importance of these channels, and any theory which fails to emphasize the necessity for these changes must be condemned as inadequate.

What Lowe has done, especially in "The Path of Economic Growth," is to look much more closely, analytically, and constructively at Fisher's 'organic relationships': to show the structural problems involved in changing them. He has done much more than stress their importance.

Model-building has two main purposes: to improve mathematical economics and the methods by which a question is examined; and, hopefully, at the same time, improve our knowledge of real-world problems. In our era there is even disagreement on what are the key questions to be examined. Little wonder that there is not a simple consensus on the policy prescriptions that flow from much model building. Bensusan-Butt drew attention to such problems some year ago: (1966, 36):

... growth theory is inherently more difficult and complicated than static theory, and it is still early days in its history. All the models we have so far are five finger exercises. They argue from assumptions that do crude violence of one kind or another to the facts of real economic life, and in consequence the stories they tell cannot possibly fit reality at all closely. We choose these assumptions because they are simple enough to yield models we can work out with the logical precision nowadays fashionable.

What Lowe has tried to do is to work from assumptions that do not ignore vital features of the production process, even if this means some sacrifice in the sophistication of technique. His choice has been a deliberate one, even if this reduces his appeal to the more technocratic in the profession. The problems and issues that have concerned him since the 1920's are far from passe in the 1980's. Indeed, they are central to debate in our era. Whether his lengthy campaign for greater recognition of 'structure of production' issues, will be taken more seriously by analysts and policy-makers in the 1980's remains to be seen. But those who are prepared to grapple with his arguments will be amply rewarded.

## VII. POSTSCRIPT

The 'Kiel Circle' was effectively destroyed by the events of the 1930's and German economics in the post-Nazi era has shown a strong neo-classical bias (See Vogt, 1971). A comprehensive survey of Austrian capital theory and its critics (Faber, 1979) manages to ignore completely the Lowe style critique and efforts by von Weizsacker (1971) and FehI (1976) to redefine the period of production are still based on the assumption that fixed capital does not exist. Hicks has rejected the analytical utility of the period of production but still works on the assumption that 'the characteristic form of production is a sequence, in which inputs are followed by outputs' (1973, 1934). Similar efforts to defend the Austrian approach by Lachmann (1959 and 1966) have also ignored the importance of the 'circularity' of the production process.

## FOOTNOTES

- 1 For more details on the origins of the 'linear' approach to production see Joseph and Bode (1935), Nurkse (1935), Kuenne (1971) & Schumpeter (1954, 1026-52). Dorfman (1959, a and b) are useful expositions of Boehm-Bawerk's impact. Veblen's critique of Boehm-Bawerk's theory remains insightful (Veblen, 1934).
- 2 The best survey of the general debates and an extensive bibliography is provided by: N. Kaldor (1937) Boehm-Bawerk's indirect influence in the 1930s was widespread. J.R. Hick's Value and Capital (1939), ch. 17, contains a constructive reinterpretation, which according to J.A. Schumpeter (1954, 9-9, n. 49) shows that his ideas worried Hicks. See also P.H. Douglas, The Theory of Wages (1934), especially chart 9, p. 128. The main attempts to improve Boehm-Bawerk's approach in the 1930s were C.H.P. Gifford and J. Marschak (1934). Attention should also be drawn to F.H. Knight's reply to Kaldor's survey article and Kaldor's rejoinder in the two subsequent issues of *Econometrica*. Kaldor's views on neo-classical approaches to capital theory have changed greatly since 1937 (see, for example, Lutz and Hague, 1961, 294).
- 3 Wicksell generalized the theory of capital by including land in the analysis, by introducing the assumption of variable production coefficients or factor proportions, and by extending it beyond the confines of a one-commodity economy into a multiple-commodity general equilibrium treatment. For the purposes of this study, his most important contribution was to formulate a method of quantifying real capital in two separate ways: as a determinate time structure of production with two dimensions 'width' and 'height'; and as a quantification in value terms. The latter he termed, 'the stratification of capital through time'. See K. Wicksell, "Lectures on Political Economy," Vol. I (1934). For a detailed analysis of Wicksell's work (Uhr, 1960). See also: Neil (1967); Hirschleifer (1967); and Lutz (1966).

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