

## COOPERATIVE RESEARCH

It has been customary to give, in the June issue of the *Bulletin*, an account of our annual planning conference. This year it has been postponed because our cooperative program made so much progress after the Shawnee Conference in September (see *Bulletin* 58) that it was felt desirable to appoint an Executive Director who could devote time to its constructive planning and to following its various features. Happily Joseph H. Willits, Dean of the Wharton School of Finance and Commerce, University of Pennsylvania, a member of our Board of Directors since 1927 and its present Chairman was persuaded to undertake the task. One of his first duties, which begin in the autumn, will be to confer with representatives from the cooperating universities to report on the year's progress and to plan for improvement and expansion of a coordinated research program.

In *Retrospect and Prospect* Dr. Mitchell mentioned the establishment of the secretariat for the Price Conference, under the chairmanship of F. C. Mills, and outlined the projects suggested at the Income Conference, of which Simon Kuznets was elected chairman. We give a brief summary of developments since the publication of *Retrospect and Prospect*.

## Income

In accordance with the instructions of the Income Conference the Executive Committee has set up a separate committee on concepts and terminology: Dr. Morris Copeland, chairman; Dr. Winfield Riefler and Dr. Simon Kuznets. The task of this committee is to prepare a report containing a clear exposition of the various terms, with the object of bringing about a better understanding of their significance and application and thereby helping to promote a greater uniformity of usage.

A committee was also organized to consider the possibility of a comprehensive tabulation of the individual state income tax returns for Wisconsin. Harold M. Groves was elected chairman, and Simeon Leland, Simon Kuznets and Aaron Director members. The committee met at Chicago with a group from Wisconsin, including Harry Jerome of the University of Wisconsin and Leonard Krueger of the Wisconsin State Tax Commission. A small subcommittee undertook to work out plans for the tabulation project, and submit it for consideration to the Works Progress Administration of the State of Wisconsin.

Arrangements have been made to have several problems in the field of income and wealth measurements discussed at the annual meeting of the American Economic and Statistical Associations. The Executive Committee of the Conference has arranged for the presentation of reports on the following topics: (1) Treatment of Government Income and Expenditures in Its Bearing upon the Mea-

surement of National Income and Wealth (by Professor Gerhard Colm of the Graduate Faculty of the New School for Social Research); (2) The Concept of Income Employed in Income Taxation (by Professor Carl Shoup of Columbia University); (3) Problems in Measurement of Purchasing Power of Net Farm and Net Urban Income (by a member of the staff, not yet designated, of the Bureau of Agricultural Economics); (4) Problems in the Measurement of Labor Income (by Mr. Solomon Kuznets of the U. S. Bureau of Labor Statistics). The discussants of these reports, who have to date accepted our invitation to act in that capacity, are J. D. Black, M. R. Benedict, J. R. Blough, Mabel Newcomer, and Leo Wolman.

## Prices

Further attention has been given to the possibility of cooperative research on the price problems of industry and trade. A meeting of industrial experts and economists was held at the National Bureau on February 21. The members of this group were agreed on the desirability of attaining the following objectives:

1. More accurate determination of the actual price changes among manufactured goods, account being taken of changes in quality and in design.
2. The measurement of production costs, both average and differential.
3. The measurement of changes in industrial productivity, and the determination of cost and price changes accompanying them.
4. The measurement of price-quantity relations (i.e., the determination of changes in demand associated with given changes in price).

The Price Conference also is planning for round table discussions of problems of vital concern to its field at the next meeting of the scientific societies. Meanwhile it is arranging for small committees of economists and industrial experts whose business it will be to explore the problems that would be encountered in given industries, and to frame programs of research for these industries. Such a committee has been set up in the textile field, under the chairmanship of S. J. Kennedy, an economist for the Pacific Mills. It is proposed that similar committees be established for coal, boots and shoes, and automobiles. The several programs of research that will be framed by these committees will be circulated in advance of the December meetings, and will be subjected to critical review at that time. With carefully tested programs in hand, it is hoped that means will be found for prosecuting one or more of these industry studies.

The Committee is also collaborating with groups at Harvard, Pennsylvania, and Pittsburgh Universities, who are studying or planning to study prices and costs in American industries.

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## Measures of Capital Consumption, 1919-1933

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### THE ACCOUNTING CONCEPT OF CAPITAL CONSUMPTION

We may most conveniently clarify our notions of the meaning of capital consumption by considering what is implied by the term in business practice. Capital consumption, as the business man sees it, is chiefly represented by deductions from asset accounts (or additions to corresponding valuation accounts), and to a lesser extent by certain direct charges to operations. The relevant entries used in recording the consumption of fixed capital (to which we confine ourselves in this *Bulletin*) include those arising from the following:

1. Depreciation
2. Depletion
3. Retirement and abandonment
4. Destruction by accident
5. Loss on sale
6. Write-down
7. Repairs, renewals and maintenance
8. Capital expenditures charged directly to current operations

To obtain a national total of capital consumption mere transfers among enterprises are eliminated, as in a consolidated statement, except to the extent that they give rise to changes in book values.

Depreciation and depletion charges are estimates, admittedly and of necessity crude, made by the business man on the basis of whatever experience is available. The rate of depreciation or depletion is not the only element approximated. Even the book value to which it is applied, although more definite only if it represents original cost, is itself merely an approximation to the current value of the capital goods being depreciated or depleted. The nature of this approximation, and the bias inherent in it, will concern us later.

Entries arising out of retirements and abandonments may represent losses through depreciation, depletion and obsolescence for which inadequate allowance had been made; or they may constitute the method of currently recording capital consumption. In either case, they represent pri-

marily a *post facto* determination of loss. This is not to imply that this determination is entirely devoid of foresight. The abandonment of workable equipment always manifests a judgment as to the future.

The value of property accidentally destroyed is not equal to the deduction made for the destruction if there is any insurance reserve on the books of either the enterprise concerned or its insurance company. We may look upon such destruction as equivalent to the retirement of fully depreciated equipment, in which case part of the insurance premiums (or other charges) has already covered the loss incurred. Or we may record such destruction only when it actually occurs. The former method is the common way of handling these deductions. The latter, however, is more convenient statistically. Since insurance reserves are set up, or their absence justified for large concerns, because such destruction is fairly regular in time and therefore predictable within reasonable degrees of error, the two amounts tend to coincide. The difference between book value of destroyed property and the sum of salvage value and insurance payments chiefly indicates a change in price levels. (More is said of these price changes below.) Types of destruction not commonly taken into business calculations may only be mentioned in this *Bulletin*.

Write-downs of the values of capital goods as well as losses on their sale may, like losses on retirement or abandonment of equipment, indicate inadequate estimates of previous capital consumption. But these entries may also, perhaps more often, represent changes in prices (or even in interest rates). If use is made of original cost—or, indeed, of any estimate not as of the most recent date—price changes will become apparent upon the disposal of plant or equipment. To the extent that write-downs result in lower depreciation charges (and that is one reason given in their justification), it is necessary to include them if we are interested in measuring capital consumption in terms of dollars of original investment and if we are not to suffer an omission from our aggregates. Similar reasoning holds for

write-ups, which increase depreciation charges. However, since the income tax laws do not permit this kind of change to affect depreciation and depletion charges, and since we use depreciation data derived from tax returns, we have omitted from consideration, in this *Bulletin*, charges arising from write-downs.<sup>1</sup>

In all businesses there are minor elements, and in some industries major elements, of capital loss that are not passed through the asset accounts but are recorded when replacements are made. The entry resulting is a charge to repairs, renewals, and maintenance. The expenditures incurred in these restorations of capital are in many ways current prime costs and do not represent the consumption of capital in any ordinary sense. This is obvious when these expenditures fluctuate with output, or more definitely, with the use of capital goods (allowance being made for seasonal movements). But to the extent that they do not do so, by the amount of consequent over- or under-maintenance, we have the formation or consumption of capital. As we shall see, the total magnitude of these expenditures is quite large. A relatively small deviation from 'normal' maintenance may mean a large absolute change in capital. These expenditures, therefore, merit attention even though they fall outside the category of credits to asset accounts. 'Extraordinary' repairs and renewals that are charged to reserves for depreciation presumably represent capital formation.

As a rule capital expenditures, except occasionally those involved in acquiring intangible assets, are not charged immediately to current operations. Other exceptions occur in secret reserves and development costs in the mining industries. The latter, while including intangibles (they are, in fact, usually called by that term), also involve expenditures upon material things. We shall therefore include them, to complete our list. These also do not take the form of credits to asset accounts, except on the supposition of a simultaneous setting up and writing off of a capital asset.

The entries in the above categories are restricted to those relating to fixed capital: in this *Bulletin* we limit our attention to the type of business capital resident in fixed assets, other than land. These assets include plant, equipment, furniture and fixtures, improvements of real estate, and exhaustible resources. Land, business inventories, intangible assets, and durable goods in the possession of non-business entities—consumers and public and semi-public bodies—are not considered here, with one exception. Estimates of the consumption of capital invested in residences are presented in an appendix. Owing to lack of data it is

<sup>1</sup> In the National Bureau study of capital consumption of which this is an interim report, it is hoped to consider the amount of these revaluations in some detail; examination of reports made to the Securities and Exchange Commission indicates their wide prevalence.

impossible to show separately the depreciation of residential structures held by business concerns. It is combined with the depreciation of other rented residences (Appendix Table III).

In the next section we attempt to determine the quantitative importance of the items in the various categories listed above and to indicate their fluctuations during the last fifteen years. It must be remembered that full data with which to fill out our outline quantitatively are unavailable. In more instances than we would wish the information is incomplete. This follows from the very nature of the underlying phenomena, which are subtle, gradual, not susceptible of easy record, and entwined with the hopes and fears of business venture.

#### ACCOUNTING ESTIMATES OF CAPITAL CONSUMPTION

Available figures on the most important elements of capital consumption, supplemented by estimates of varying degree of reliability, appear in Table 1. These accounting estimates are 'institutional' estimates in the sense that they were made in accordance with current modes and habits of estimation.

The deficiencies of our data are numerous. Losses due to retirement and abandonment are given for only one industry—steam railroads. (These appear in greater detail in Appendix Table I.) Destruction by accident is estimated only for fire losses; however, these probably constitute the major part of such deductions. Losses on sale of capital assets and write-downs are not given at all. Repairs and renewals are given only for public utilities, together with major repairs and alterations of buildings. Development expenditures in mining industries constitute the only data available on capital expenditures charged directly to current operations.

One reason for the absence of data is the minor importance of some items. This appears to be the reason in the case of losses on the sale of capital assets. When reported in corporate financial statements, the amounts given are usually small. No reliable estimate may be made on the basis of figures published by the Treasury Department in *Statistics of Income*. The losses compiled by the Treasury Department are given only in combination with losses on the sale of investments (stocks and bonds). While the total of these two types of loss has been large in each of the years 1931-33, it is probable that losses incurred in disposing of investments have constituted the bulk of the total. This presumption is strengthened by the fact that companies in the financial field have reported over half the losses.

Write-downs, however, although omitted are important. A rough estimate, made in *Bulletin 55* of this series (p. 10), indicated that several billion dollars of capital assets were written off by industrial corporations alone in the

TABLE 1  
ACCOUNTING MEASURES OF BUSINESS CAPITAL CONSUMPTION, 1919-1933, BY TYPE<sup>1</sup>  
(in millions of dollars)

YEAR	DEPRECIATION	DEPLETION	DEPRECIATION AND DEPLETION	REPAIRS, RENEWALS AND MAINTENANCE	DEVELOPMENT EXPENSE (MINING)	FIRE LOSSES	TOTAL
1919			3,797	2,589	334	126	6,846
1920			4,154	3,305	495	176	8,130
1921			4,128	2,706	286	195	7,315
1922			4,435	2,682	312	200	7,629
1923			4,713	3,061	392	211	8,377
1924			4,825	2,762	338	216	8,141
1925	4,561	524	5,085	2,698	351	220	8,354
1926	5,109	614	5,723	2,841	373	221	9,158
1927	5,166	540	5,706	2,876	322	186	9,090
1928	5,472	555	6,027	2,735	304	183	9,249
1929	5,870	596	6,466	2,906	321	181	9,874
1930	5,940	493	6,433	2,442	260	198	9,333
1931	5,886	291	6,177	1,946	173	178	8,474
1932	5,475	263	5,738	1,365	134	158	7,395
1933	5,258	264	5,522	1,316	139	106	7,083

<sup>1</sup> A more detailed breakdown is given in Appendix Table I. Sources and methods of estimation appear in footnotes of that table. Properly to understand these figures requires careful attention to the methods of estimation as well as to the discussion in the text. Depreciation and depletion charges are not available separately for years prior to 1925 (see Table 5, footnote).

two years 1931 and 1932. But these revaluations need not concern us at least in so far as the general magnitude of the figures in the table is considered over long periods.

The business depreciation charges are based on those reported to the Treasury Department for use in the determination of income taxes. There is reason to believe that the basic depreciation rates are somewhat higher than would be used for determining net income for other than tax purposes. They would thus tend to include at least some allowance for that type of capital loss which ordinarily is expressed in lump sums in the form of write-offs and abandonments. The latter, of course, are not deductions recognized by the income tax laws.

Not only may the depreciation figures *accepted* by the Treasury Department be higher than those that would otherwise be charged; the figures *reported* may even be higher than those *accepted*. That this is not rare is shown by adjustments made in published financial statements increasing surplus for excess depreciation charges not allowed by the Treasury Department.<sup>2</sup>

The degree of overstatement may show a secular decline, especially as company estimates are reduced by governmental audit and accountants become better acquainted with what is acceptable to the tax authorities. To the extent that this occurred, the advance over the period being reviewed is understated.

<sup>2</sup> On the other hand, even the reported charges may appear too low to those who would make large allowances for future obsolescence. Only 'normal' obsolescence is recognized by tax authorities, except at actual retirement or other disposal of equipment.

The rise in business charges for depreciation is irregular from year to year, and is probably affected by slight changes in coverage. The only definite decline in depreciation charges began in 1931. The decline in total depreciation and depletion charges in 1927 and 1930 was due to the sharp cyclical fall in depletion charges. The excess of investments over retirements resulted in a rise in the volume of capital goods from 1926 to 1927, and from 1929 to 1930. Depreciation charges also rose, as a consequence both of this increase in the amount of depreciable assets and of the prevailing use of some form of the straight-line depreciation formula. In 1931, however, a decline set in and continued for the remainder of the period covered in our table. This decline in 1931-33 tentatively suggests an excess of business capital consumption over gross capital formation.

The rise in depreciation charges over the decade of the 'twenties was the result chiefly of an increase in capital goods and of the persistence of high price levels relative to pre-War costs. As will be shown in more detail below, even if the number and efficiency of buildings, machines and other equipment had remained constant, the price factor alone would have caused a secular rise in depreciation charges.

Depletion charges are essentially rough estimates under any conditions. The figures here presented acquire peculiar characteristics, further, from the tax law provisions regulating their computation. Depletion charges may be based on cost, on discovery value, or on gross value of mineral output, depending on the type of exhaustible resource, on

the year for which they are computed, and on the election of certain alternatives offered to the taxpayer. Further, they may sometimes be limited in amount to a figure equal to or even less than the computed net income before depletion.<sup>3</sup> In prosperous years depletion charges computed on the basis of discovery value or gross income may exceed the amounts necessary to recover capital depletion. In years of depression, when net income before depletion is low, they may fall short of these amounts. The cyclical movements of estimates of actual depletion (and profits) will thus tend to be exaggerated. For these reasons the depletion charges shown here must be accepted with caution. The tax laws have acted, however, not only to distort the entrepreneurial estimates. Were it not for the legal requirement for such estimates, it is doubtful that any deductions would be made in many instances. The situation prevailing before the War is revealing. Although these particular estimates are rough and distorted in many respects, they constitute at least a first approximation to the depletion our natural resources have suffered.<sup>4</sup>

The volume of repairs, renewals and maintenance is shown to be rather large, relative to depreciation charges. This is primarily a consequence of the accounting methods prevailing among the public utilities. In this industry we find maintenance of capital taking the form chiefly of repairs and replacements. Among railroads, for example, practically no depreciation is charged on ways and structures, on the theory that they are fully maintained by current repairs and replacements. To the extent that plant and equipment are in fact not fully maintained we have under-maintenance. This may of course be followed by over-maintenance when delayed repairs are finally made.

Repairs and renewals in industries other than public utilities and real estate also reach a large total. If we may judge from the reports made to the Securities and Exchange Commission by eighty-three large industrial corporations, charges for repairs and renewals ran on the average about equal to depreciation charges in 1934.<sup>5</sup> Much of these charges represents current production costs. However, since their amount is probably great, even a slight deviation from normal maintenance (in the form of deferred repairs, for example) may mean an appreciable volume of capital consumption or formation.

<sup>3</sup> A brief statement of the various provisions and their changes in successive revenue acts is given by R. C. Epstein, *Industrial Profits in the United States* (National Bureau of Economic Research, 1934), p. 328.

<sup>4</sup> Such types of depletion as exhaustion of the soil are not included since no estimates whatever are made by those directly concerned. Rough estimates of soil depletion have been made by the National Resources Board; see the *Report* of December 1, 1934, pp. 15-17.

<sup>5</sup> Data for earlier years are not available except for a few companies, insufficient in number to provide reliable information on annual movements.

The estimates of fire losses of capital equipment are surprisingly small. There are two reasons. First, the rate of fire loss has been decreasing steadily over the last century, and the declining trend is visible even in the last fifteen years. The annual rate of premium charged per hundred dollars of insurance has fallen radically. For one company, the Manufacturers Mutual, the figures (as published in *The Factory Mutuals, 1835-1935*), are as follows:

1845	\$ .84	1895	\$ .162
1855	.39	1905	.112
1865	.308	1915	.066
1875	.355	1925	.033
1885	.229	1935	.028

Second, during the period covered by the present estimates no conflagration of major proportions occurred. The San Francisco fire of 1906 cost the nation about 350 million dollars: over 25,000 buildings and their contents were destroyed. Obviously, one major disaster like this can wipe out a large fraction of a year's gross increment in capital.

Perhaps more important than such spectacular occurrences, which are rare and of diminishing probability, are the losses arising from soil exhaustion and erosion, which are indirect as well as direct. Since these losses are slow in accumulating, and are not obvious in any case, it is easy to overlook them. Absence of business estimates covering them indicates as much.

A factor affecting the relative values of the several types of capital consumption presented in Table 1 is the average durability of capital goods.<sup>6</sup> If the average life of producers' equipment were shorter, it is improbable that depreciation charges would be affected to the same extent as fire losses.

#### ACCOUNTING ESTIMATES AND ECONOMIC CONCEPTS

Most broadly defined, the consumption of business capital is measured by the sum of the above entries on the books of business concerns. A somewhat narrower concept omits changes in book valuations arising from the recognition and recording of substantially new price levels, namely, a large portion of write-downs and of losses on sale.

It must be remembered, however, that these measures are aggregates of accounting data, and are based on the accounting concept of capital consumption. Are they satisfactory measures from a social standpoint?

The accountant's conceptions of cost constitute economic forces which affect the conduct of business and the laws of value and production.<sup>6a</sup> Therefore, regardless of the accuracy of the business estimates of capital consumption,

<sup>6</sup> Adequate consideration of this factor raises interesting problems involving rates of interest and prices of capital goods as well as durability. But they cannot be examined here.

<sup>6a</sup> J. M. Clark, *Economics of Overhead Costs* (University of Chicago, 1923), p. x.

business records may not be mere reflections of individual cognizances. Accounts, and the limitations to which they are subject, may in turn influence the sensitivity of business men and the manner of their reaction to the fact of capital decline. But while the accounting concept and the accounting estimates of capital consumption are essential objects of study in the analysis of business behavior, they do not constitute the most adequate concept and estimates of capital consumption from the broad social point of view. In an economic evaluation of national income, savings and wealth, they can be accepted only as first approximations, subject to revision.

Thus, the recognition and recording of capital consumption by business men differ from one industry to another, from one period to another and perhaps also by size of concern. In the estimation of capital consumption from the economic point of view these differences must be taken into account. It is a question whether the particular method of evaluating capital consumption current in each business is not the one to be preferred by the economist even at the expense of consistency. It appears at first sight that the method is current because it is the most suitable under the given conditions: who is a better judge of suitability than the entrepreneur, experienced through years of contact with the special conditions of the industry? The economist, however, would be passing by the problem rather than answering it if he were to take this position. It would mean assuming that the given process of evaluation is in fact the most suitable *now*, rather than a habit inherited from the past.

There is also the general bias of business men and accountants in the direction of 'conservatism,' and their understandable penchant for the objectivity of original cost. Further, the reluctance to admit capital consumption is revealed in the not infrequent accumulations necessitating charges to capital. The question whether credits to contingency reserves, or even business savings as such, represent rough forecasts of, and provisions for, future capital losses is not clearly answered in business records. This ambiguity is itself one phase of the difficult problem of allocation in time. Of course an asset account is eventually credited for any losses that occur. But this eventual credit cannot easily be accepted as an adequate record without further consideration. Finally, there is the occasional confusion of tangible and intangible assets. In the valuation (perhaps more frequently, the revaluation) of fixed assets there is sometimes a tendency to ascribe to them monopoly values that are ordinarily imputed to intangibles. From the private viewpoint, of course, the distinction is in some ways academic and, on account of the difficulties involved, is not pressed. But monopoly values are doubtful measures in so far as the economic system at large is concerned.

These are some of the ambiguities and faults inherent

in the business concepts of capital consumption. We should not, however, expect to find satisfactory concepts being applied in business practice. Economic theory also has so far failed to provide us with satisfactory concepts of capital and capital consumption, even within the limitations theorists may impose. And for much the same reason. The difficulties involved in constructing rigorous theoretical concepts of capital consumption are identical in nature and source with many of the difficulties troubling accountants and statisticians in their attempts adequately to describe the changing status of business enterprises. Changes in relative prices, technological progress, improvements in quality of goods, the discovery and exhaustion of natural resources—all these dynamic factors continually complicate the situation with which we must deal. They subject even our unit of measurement—money—to changes that restrict its efficiency in aiding us to cope with the evolving environment. In dealing with concrete situations, further, 'non-economic' factors must be taken into account, factors that may be set aside in theoretical considerations. But although theoretical discussions have not yet led to definitive concepts, they have resulted in several valuable guide posts to the direction modification of the business concepts may usefully take.

In the next sections will be considered two striking characteristics of business estimates of capital consumption: the omission of under-maintenance and the use of cost prices.

#### UNDER-MAINTENANCE

Under-maintenance is almost inevitably a consequence of the desire to avoid making investments that may be postponed and to maintain the apparent rate of profits. For this reason the available figures are few and difficult to interpret. Secret reserves and secret drafts upon capital are, by their very nature, not made public. If maintenance costs are spread over several accounting periods on a budget basis, through reserve accounts, the data are not necessarily secret. But this method of handling such costs, although recommended by accountants where the sums are appreciable, is not widely prevalent or at least is not often revealed by available statements. Indirect evidence is the only means we have of detecting the phenomena of under-maintenance.<sup>7</sup>

<sup>7</sup> If our measures of gross capital formation contain the value of output of repair parts and similar goods, obviously we must include at least that portion of maintenance costs in the measures of capital consumption. Our treatment of both measures must be consistent. Capital formation within the business enterprise, except in public utilities and certain types of construction, and except for the value of parts used in repairs and renewals, has been excluded by Dr. Kuznets from his measures, primarily because of lack of data (see *Bulletin 52, Gross Capital Formation, 1919-1933*). The figures on maintenance presented in this *Bulletin* are still more narrowly limited to public utilities, and to major repairs

TABLE 2  
MAINTENANCE RATIOS, CLASS I STEAM RAILWAYS, 1919-1933

YEAR	MAINTENANCE CHARGES OTHER THAN DEPRECIATION, RETIREMENTS, AND INSURANCE, AS A PERCENTAGE OF OPERATING REVENUES	MAN-HOURS OF MAINTENANCE EMPLOYEES PER 100 CAR-MILES <sup>1</sup>
1919	36.20	—
1920	39.77	—
1921	33.20	—
1922	32.21	8.52
1923	32.62	8.74
1924	30.77	8.00
1925	29.90	7.46
1926	29.70	7.16
1927	29.76	6.97
1928	28.50	6.47
1929	28.31	6.39
1930	27.69	5.93
1931	26.49	5.32
1932	23.93	4.95
1933	22.94	4.67

Source: Derived from various data collected by the Interstate Commerce Commission and published in the annual issues of *Statistics of Railways*.

<sup>1</sup> Comparable data are not available for 1919-21.

The most detailed—and the most adequate—figures bearing on the general question of under-maintenance in business establishments are those compiled by the Interstate Commerce Commission from the reports of steam railroads (Table 2). During the 1920's a declining trend is evidenced in the ratio of maintenance expenditures to gross operating revenue, with pronounced cyclical falls obvious in 1921 and in 1930-33. The trend is probably due to diverse price movements and to changes in technique. Further evidence is afforded by the ratio of man-hours of maintenance employees to car-miles of traffic. Use of this ratio avoids the difficulties arising from diverse price movements. The element of secular decline arising from changing technical methods remains, however, and obscures the conclusions to be drawn from the data. But even if we assume that the trend apparent in the preceding ten years continued through 1930-33, there is definite evidence of under-maintenance of some 15 per cent in 1933 relative to 1929. If deterioration goes on and maintenance be required whether or not traffic declines—and to some extent this is so—the degree of under-maintenance is considerably greater than this figure would suggest. Direct evidence of under-maintenance is provided by quantity figures on maintenance of track and equipment (Table 3). Beginning with 1930 the secular declines apparent in the replacement of rails and ties appear to have speeded up, and by 1932 and 1933 replace-

and alterations of buildings. For these and other reasons, comparisons between the figures in this *Bulletin* and those of Dr. Kuznets may not be made without sundry adjustments.

TABLE 3  
MEASURES OF MAINTENANCE, CLASS I STEAM RAILWAYS, 1919-1934

YEAR	REPLACEMENTS		PERCENTAGE OF UNSERVICEABLE EQUIPMENT <sup>1</sup>		
	Rails (thousand tons)	Ties (million)	Freight cars	Locomotives	Passenger Freight
1919	2,335	80.9	—	—	—
1920	2,507	86.8	7.0	24.8	24.5
1921	2,588	86.5	13.1	23.1	24.0
1922	2,619	86.6	12.8	23.5	25.5
1923	3,139	84.4	8.0	20.8	21.6
1924	3,185	83.1	7.8	18.4	18.8
1925	3,485	82.7	7.7	17.8	17.8
1926	3,818	80.7	6.5	17.0	16.4
1927	3,819	78.3	5.9	16.4	16.1
1928	3,806	77.4	6.2	16.4	16.3
1929	3,610	74.7	6.0	16.2	16.4
1930	2,674	63.4	6.2	17.0	17.5
1931	1,715	51.5	7.8	20.5	20.7
1932	797	39.2	10.6	24.9	26.6
1933	862	37.3	14.1	28.6	32.7
1934	1,165	43.3	14.6	29.3	33.8

Source: Figures collected by the Interstate Commerce Commission, some of which are published in *Statistics of Railways*.

<sup>1</sup> Comparable data are not available for 1919.

ments were only a fraction of the 1929 amounts. The decline in rails replaced from 1929 to 1932 reached the large figure of 78 per cent; replacement of ties dropped one-half from 1929 to 1933. The piling up since 1929 of equipment requiring repairs confirms the evidence already presented.

#### CAPITAL CONSUMPTION IN CONSTANT AND CURRENT PRICES

Until gains, or even losses, are realized by exposure and sale in the market-place, capital assets are usually valued on the books of a business enterprise in terms of their original cost. As a consequence of this method of accounting, one supported by the requirements of the tax laws, depreciation charges represent an amalgam of non-contemporaneous prices. The various items of capital equipment and buildings are of diverse average spans of life. The anticipated useful life of the capital goods produced in 1929, for example, ranged from two years to one hundred, with concentrations (indicative of the approximate character of the estimates) at 10, 15, and 20 years (see Table 4). Half of the 1929 output in value had an anticipated life of between 10 and 30 years; one-fourth exceeded 30 years. We are not wrong in supposing, therefore, that even as late as 1929 capital goods purchased at 1913 and earlier price levels were still being depreciated.

The measures in Table 1 are strictly comparable in the sense that they represent the accounting estimates of capital consumption for the year to which they refer. As such their significance in an analysis of economic behavior cannot be denied. But to the extent that the price units actually

TABLE 4  
VALUE OF OUTPUT OF BUSINESS CAPITAL GOODS IN 1929, DISTRIBUTED BY LENGTH OF ANTICIPATED USEFUL LIFE<sup>1</sup>

LIFE <sup>2</sup> (years)	VALUE OF OUTPUT (percentage of total)	CUMULATED VALUE OF OUTPUT	DEPRECIATION RATE (per cent)
75	0.3	100.0	1-1/3
50	5.1	99.7	2
44	1.4	94.6	2-1/4
40	7.5	93.2	2-1/2
35	4.0	85.7	2-6/7
33	3.8	81.7	3
30	4.5	77.9	3-1/3
29	2.6	73.4	3-1/2
25	5.9	70.8	4
22	1.0	64.9	4-1/2
20	9.5	63.9	5
18	2.8	54.4	5-1/2
17	1.4	51.6	6
16	1.5	50.2	6-1/4
15	11.0	48.7	6-2/3
14	2.2	37.7	7
13	0.6	35.5	7-1/2
12.5	3.0	34.9	8
12	2.7	31.9	8-1/3
11	0.5	29.2	9
10	7.6	28.7	10
9	0.4	21.1	11
8	2.8	20.7	12-1/2
7	1.6	17.9	14
6	4.2	16.3	16-2/3
5	4.3	12.1	20
4	3.9	7.8	25
3	2.0	3.9	33-1/3
2.5	1.1	1.9	40
2	0.8	0.8	50
Total	100.0		

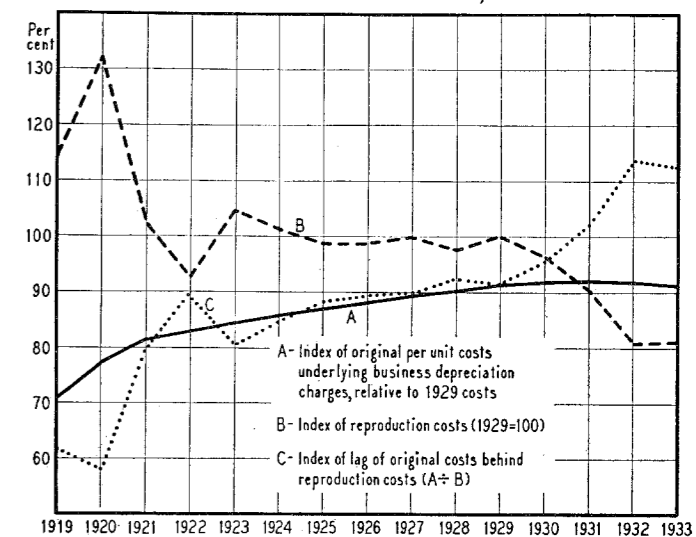
<sup>1</sup> The depreciation rates are taken from *Depreciation Studies—Preliminary Report of the Bureau of International Revenue* (1931). They have been appropriately weighted by the value of business capital goods of each average life span produced in 1929. The weights were derived from the *Census of Manufactures* and Dr. Kuznets' estimates of construction (*Bulletin* 52).

<sup>2</sup> Reciprocal of depreciation rate, not allowing for scrap value.

used in the evaluations are not contemporaneous, the meaning of the measures is obscured. Such items as repairs and fire losses are already priced in current units. But charges for depreciation, depletion, and retirements are in terms of prices paid at the time of original investment. If we are to modify these charges in order to express them in the prices of some common period, rather than in the original cost prices of many periods, a step must be taken beyond Table 1.

Price changes themselves result in one form of capital consumption (and formation) as it appears in the computations of business men. (Write-downs, the major type of entries taking specific account of price changes, have been omitted from the present set of figures, however.) In reducing the measures in Table 1 to contemporaneous price units, therefore, we are ignoring the effects of some of these

CHART 1  
ESTIMATES OF ORIGINAL AND OF REPRODUCTION PER UNIT COSTS, 1919-1933



changes. From a social point of view this is defensible on the ground that a general deflation of values does not in itself signify the loss of physical capacity to produce.

As a result of the great fall in the purchasing power of the dollar during the War, the prices implicit in depreciation charges were usually lower than the prices actually paid for replacements. This situation, revealed by the indexes in Chart 1, prevailed during most of the period we are observing. The index portrayed by the solid line represents the original cost prices on the basis of which depreciation charges are computed, as a percentage of the corresponding 1929 prices.<sup>5</sup> Thus, in 1929 the original cost prices of the equipment and buildings being depreciated averaged about 9 per cent less than reproduction costs in 1929. In 1919 the prices originally paid for capital assets in existence averaged some 29 per cent less than 1929 prices. Not until the collapse of prices in 1930 did reproduction costs fall below the amounts set aside in depreciation reserves to make possible the replacement of equipment. The extent of the lag is indicated by a line representing the ratio of this index to an index of current prices.

It is this index of the original cost prices underlying depreciation charges that we must use in reducing the charges

<sup>5</sup> The index is an harmonic mean of various available indexes of prices of capital goods and construction costs weighted by the estimated depreciation charge applicable to the goods produced at the given prices. The harmonic mean of prices was employed because, when used to deflate a value series, it yields a series expressed in constant prices.

The underlying price indexes, especially those of construction, are not entirely satisfactory, and the weights used are rather rough. There can be little doubt, however, that the picture as a whole is as outlined here.

The figures are given in Appendix Table II, with some further details on the method of computation.

to constant dollars. The deflating index number is, in many respects, a peculiar price level. It measures one of the factors tying together different periods and suggests the extent of the influence of previous prices upon the present economic situation. As such it represents an institutional force of some weight and indicates one lagging element through which rising prices are a stimulus to business enterprise, and declining prices are a depressant.

The depletion charges in Table 1 also are composites including prices determined in different years. The adjustment of depletion charges, although somewhat analogous to modifying depreciation charges to reflect changes in prices, presents additional difficulties. Unlike depreciation charges, which are computed chiefly as a percentage of original cost, depletion charges are based on a more heterogeneous mixture of prices. The basic values used relate to discovery values as well as to cost, and in some instances depletion charges are calculated simply as percentages of gross income. In a stationary state we might measure depletion by an amount "adequate to provide some form of man-made capital equivalent in 'value' to this wear and tear."<sup>9</sup> In a dynamic industrial system, however, the task is more difficult and only the roughest approximations are possible. This is recognized in the entrepreneurial estimates themselves, and in the degree of reliability ascribed to them by business men and accountants.

<sup>9</sup> A. C. Pigou, *Economics of Stationary States* (Macmillan, 1935) p. 22.

In this *Bulletin* we attack the problem of reducing depletion charges to constant dollars by going directly to an index of output of raw minerals and forest products. This index is taken to represent the movements of these charges had they been expressed in constant dollars. The index of depletion thus derived may be expressed in dollars by the further assumption that the actual charges in some one year are correct. We select 1929 as this base. Only slightly different results are yielded by the use of other years.

To express depletion charges in 'current' dollars is even more difficult. The use of prices of mineral products or of mines and timber tracts is either incorrect or impossible. For our purposes we might, with some reason, use an index of the general price level or of the prices of capital goods. The latter is our most readily available choice. This assumes that among other things our knowledge of mineral resources is constant, that technological changes have been relatively unimportant, and that relative price changes have been small. These are bold assumptions, of course, involving as they do the absence of change in the chief elements characteristic of a dynamic economy. However, any other reasonable treatment would affect the total but slightly since depletion charges constitute a relatively small portion of our total.

The estimates in Table 1 other than charges for depreciation, depletion and retirements, are already in terms of current prices. Their deflation by appropriate indexes to convert them into constant dollars expressed in 1929 prices

TABLE 5  
MEASURES OF BUSINESS CAPITAL CONSUMPTION, 1919-1933, BY TYPE, IN TERMS OF 1929 PRICES<sup>1</sup>  
(in millions of dollars)

YEAR	DEPRECIATION	DEPLETION	DEPRECIATION AND DEPLETION	REPAIRS, RENEWALS AND MAINTENANCE	DEVELOPMENT EXPENSE (MINING)	FIRE LOSSES	TOTAL
1919	4,662	409	5,071	2,225	292	110	7,698
1920	4,584	460	5,044	2,438	374	133	7,989
1921	4,569	363	4,932	2,638	279	190	8,039
1922	4,820	390	5,210	2,921	337	216	8,684
1923	4,952	523	5,475	2,905	374	202	8,956
1924	5,007	495	5,502	2,717	333	213	8,765
1925	5,249	511	5,760	2,753	356	223	9,092
1926	5,806	545	6,351	2,889	378	224	9,842
1927	5,789	548	6,337	2,878	323	187	9,725
1928	6,065	548	6,613	2,806	312	188	9,919
1929	6,443	596	7,039	2,906	321	181	10,447
1930	6,464	514	6,978	2,503	270	206	9,957
1931	6,391	424	6,815	2,173	192	197	9,377
1932	5,958	344	6,302	1,675	166	196	8,339
1933	5,765	372	6,137	1,646	172	131	8,086

<sup>1</sup> Derived by dividing the figures in Table 1 by the appropriate price indexes in Appendix Table II, except in the case of depletion charges, for which see the text.

The separation of depreciation from depletion charges, 1919-24, has been estimated with an error that is small relative to depreciation charges. The estimated breakdown is not given in Table 1 since the error in the above separation may be large, for depletion charges. As mentioned, depletion charges in constant dollars were derived by a procedure not making use of this estimate.

therefore requires no explanation. The deflators are given in Appendix Table II.

The results of the conversion of the estimates in Table 1 into fixed prices are presented in Table 5. The year 1929 has been selected as the base. The average of a broader period such as 1925-29 as the base yields much the same results as does the use of 1929. We are here measuring the declines in capital goods in terms of constant prices instead of the varying cost prices appearing on the books of business enterprises.

In Table 6 the same series are expressed in terms of the prices current year by year, that is, the estimate for 1925 is in terms of 1925 prices, and so on. Only the changes in per unit replacement costs are eliminated by expression of capital consumption in terms of either current or cost dollars: changes in values arising from obsolescence remain, and properly so. We thus make comparable our estimates of capital consumption and gross capital formation and in this way obtain a measure of net capital formation that is not ambiguous, from the economic point of view.

Expressing the estimates of depreciation in current prices implies measuring the capital consumption represented as if price changes were reflected periodically on the books of business enterprises. It enables us to distinguish between two types of capital consumption and thus aids in the analysis of the causes of capital consumption. This distinction is between the decline in value and the value of the decline of capital goods. But we need not attempt to name *the*

correct concept. For certain purposes it is convenient to use the concept of capital consumption that is confined to measures of depreciation, depletion and obsolescence. For other purposes the inclusion of value changes other than those arising from depreciation, depletion and obsolescence is more suitable. The figures in Tables 5 and 6, in constant and in current dollars, follow the first concept. Obviously it does not agree with the *business* concept.

The various measures presented in Tables 1, 5, and 6 are brought together in Chart 2, which makes graphic comparison possible.

As was suggested earlier the rising trend of business depreciation charges was partly a consequence of the change in price levels from 1913 to the post-War period. Elimination of the price changes leaves a less rapidly rising trend, but still one averaging about 3.7 per cent per annum between 1919 and 1929 (2.6 per cent per annum between 1919 and 1933). The response to the cyclical declines in business in years prior to 1931 is slight. Only in the major recession of 1929-33 was there a substantial decline in business depreciation charges expressed in constant dollars.<sup>10</sup>

The movements of depletion charges are naturally more responsive to the fluctuations in general business owing to the use of per unit of output charges.

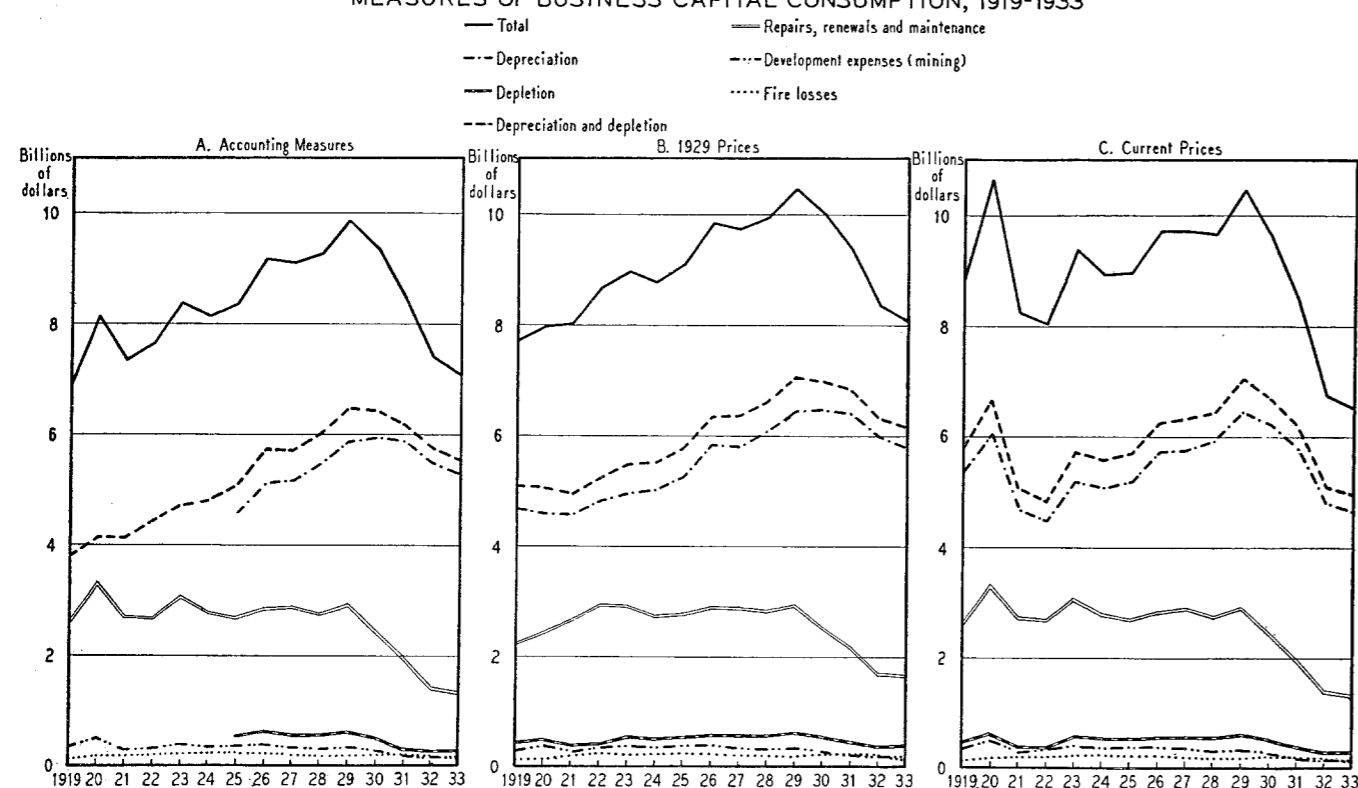
The absence of trend in repairs, renewals and maintenance charges is also noteworthy. The figures rather appreciably.

TABLE 6  
MEASURES OF BUSINESS CAPITAL CONSUMPTION, 1919-1933, BY TYPE, IN TERMS OF CURRENT PRICES<sup>1</sup>  
(in millions of dollars)

YEAR	DEPRECIATION	DEPLETION	DEPRECIATION AND DEPLETION	REPAIRS, RENEWALS AND MAINTENANCE	DEVELOPMENT EXPENSE (MINING)	FIRE LOSSES	TOTAL
1919	5,338	468	5,806	2,589	334	126	8,855
1920	6,060	608	6,668	3,305	495	176	10,644
1921	4,683	372	5,055	2,706	286	195	8,242
1922	4,468	362	4,830	2,682	312	200	8,024
1923	5,185	548	5,733	3,061	392	211	9,397
1924	5,077	502	5,579	2,762	338	216	8,895
1925	5,181	504	5,685	2,698	351	220	8,954
1926	5,731	538	6,269	2,841	373	221	9,704
1927	5,766	546	6,312	2,876	322	186	9,696
1928	5,913	534	6,447	2,735	304	183	9,669
1929	6,443	596	7,039	2,906	321	181	10,447
1930	6,218	494	6,712	2,442	260	198	9,612
1931	5,771	383	6,154	1,946	173	178	8,451
1932	4,814	278	5,092	1,365	134	158	6,749
1933	4,670	301	4,971	1,316	139	106	6,532

<sup>1</sup> The figures on repairs, development expense and fire losses are the same as in Table 1. As stated in the text, these types of capital consumption are already expressed in terms of current prices. The data on depreciation and depletion are derived from the corresponding figures in Table 5 (in constant prices), multiplied by appropriate indexes of current (reproduction cost) prices. These price indexes are the same as those given on the third line of Appendix Table II.

CHART 2  
MEASURES OF BUSINESS CAPITAL CONSUMPTION, 1919-1933



nance is a consequence of the overwhelming weight of steam railroads. This industry has shown little if any growth during the post-War decade. For the same reason there was no decline in the total in 1921: the railroads were busy restoring their equipment and other property to serviceable condition. The radical decline since 1929 is indicative of the under-maintenance already discussed.

Costs of developing mines have fluctuated with the current rate of mining output. Little can be said about fire losses although the decline since 1930 attracts attention.

The figures in Table 5, from which confusing price movements have been eliminated, make possible certain conclusions with respect to the relative importance of the several types of capital consumption:

1. An increasing proportion of business capital consumption is being recorded in the form of depreciation charges rather than charges for repairs and maintenance, chiefly as a consequence of the decline in the relative importance of steam railroads.

2. Recorded depletion charges and costs of development of our national resources declined in relative importance during the fifteen years under review.

3. Despite a large increase in the nation's capital stock, losses by fire showed no appreciable upward trend.

It is interesting to observe the influence of the high post-War prices and low depression prices upon the mea-

asures of capital consumption (Table 6). Substitution of these prices for the original cost prices underlying the accounting estimates of depreciation charges raises the values assigned to the earlier years of the period 1919-33, and lowers the values of the later years. The figures given in Table 6 provide a basis for a significant comparison with current estimates of gross capital formation of similar scope, just as do the figures in Table 1.

In deriving the figures in Tables 5 and 6 we have been forced to ignore the steady improvements in quality of equipment produced. Of course changes may be foreseen and investment made or withheld accordingly. If an investment is made under these circumstances it presumably is done in the anticipation that depreciation and obsolescence charges can be raised sufficiently to take account of the future rise in quality or fall in price. This may not be as exceptional as it seems offhand. If business men have, by long experience, been inured to such relative price changes (equivalent to improvements in quality with price constant), depreciation policies may come to anticipate them in the form of allowances for 'normal' obsolescence. However, the wide prevalence of straight-line depreciation charges means that in actual practice no attempt is made to pro-rate depreciation charges so that the anticipated losses are properly allocated over the life of the equipment. The entrepreneurial estimates of depreciation in Table 1

may therefore understate the decline in value of capital goods during the first half of their useful lives and overstate the decline in the second half. In an economy in which the volume of capital is fairly constant, however, the discrepancies tend to cancel one another. If the volume of capital is growing there may be something of a continuous lag in the level of capital charges, and therefore a continuous overstatement of annual profits. Until the day of reckoning, however, no difficulties may be anticipated. But, in fact, such a day occurs whenever there is a substantial slackening in the rate of growth of capital—that is, during every major depression.<sup>11</sup>

The difficulties of price and quality changes confront the business man as well as the economist. One difficulty is the possibility that no replacement price may be quoted or recorded in the market. This is merely a limiting case within the broad category of 'quality' changes. Here lie some of the chief causes of difficulty in accounting for capital consumption. It is partly because of changes in the quality of the new capital equipment flowing through the market that even great changes in price levels are ignored in the records of business. Quality changes are thus not simply something to be *eliminated*. Rather, from a scientific standpoint, they are something to be *analyzed*. The difficulties of adequately measuring capital consumed, of computing costs, and of pricing, arise in large part from such changes in 'quality.' It is these difficulties which help to explain some of the recognized inadequacies of current accounting methods and current price indexes.

With reference to the direction of influence of quality changes upon the indexes in Chart 1 the following may be ventured. If improvements in capital goods may be assumed to go on at a steady rate, then in order to reflect this progressive cheapening the index of current prices (the broken line in Chart 1) would be swung about the 1929 base so that the 1919-28 figures are raised and the 1930-33 figures lowered. Similar (but not exactly the same) would be the change in the solid line. The data represented by the dotted line would be least changed. But it is these figures which reveal the lag in which we are interested.

#### ESTIMATES OF CAPITAL CONSUMPTION AND THE MEASUREMENT OF PROFITS AND SAVINGS

Current methods of measuring capital consumption constitute an indispensable part of the procedure of estimating business profits, national income, savings, and national

<sup>11</sup> In so far as there is actual shortening of life, depreciation charges may understate actual depreciation and obsolescence, account being taken of the resulting losses only on retirement and abandonment of assets. However, as we have noticed, the depreciation charges available to us tend to be estimated at higher than commonly accepted rates and indeed explicitly include an allowance for 'normal' obsolescence. To that extent obsolescence and similar declines in value are allowed for regularly.

wealth. Any peculiarities characteristic of the determination by business men of their current position will thus affect not only these measures but also the influence exerted by them upon economic behavior. The computations most immediately involved are those concerned with business profits and savings. Measures of capital consumption, indeed, come into existence primarily as part of these computations. It is worth indicating the influence, upon current measures of profits and business savings, of two characteristics of business measurements—the use of original cost and of the straight-line depreciation formula in the estimation of depreciation charges.<sup>12</sup> The influence of the cost base is most prominent over long periods. During ordinary business cycles it is the prevailing use of some variety of the straight-line formula that appears to affect depreciation charges most prominently. Let us consider first the use of original cost as it affects depreciation estimates and measures of business savings.

Current prices may differ from original cost prices because of secular movements in the prices of capital goods or because of movements constituting parts of business cycles. But the short cyclical changes in the prices of capital goods are relatively small.<sup>13</sup> During recent business cycles of moderate amplitude there has been relative stability in current prices of capital goods and differences between them and the prices underlying book values have not fluctuated to any important extent. Secular movements of prices result, however, in a cumulative deviation of replacement prices from book values, which may become great. It is these larger movements that interest us in the present comparison. Even prosperity replacement costs may be on a lower secular level than original cost prices; and even depression replacement costs may be on a higher secular level than original cost prices. The magnitude of these differences in a specific historical period is indicated in Table 7.

The estimates in Table 7 of corporate savings for 1919-33 are derived, naturally, by a series of subtractions from gross income in which an estimate of depreciation in original cost prices is one of the items subtracted. If this estimate of depreciation be expressed in terms of current replacement cost, instead of in terms of original cost, we have a rather different estimate. The difference between the two (the third column) is rather large in relation to corporate savings. Modified estimates of corporate savings, in which account is taken of the differences in column

<sup>12</sup> Other business practices, such as the valuation of inventories at the lower of cost or market prices, are also of interest in this connection. But here we restrict our attention to the characteristics mentioned.

<sup>13</sup> See Frederick C. Mills, *Changes in Prices, Manufacturing Costs and Industrial Productivity, 1929-1934, Bulletin 53* of this series.

TABLE 7  
MEASURES OF DEPRECIATION AND OF CORPORATE SAVINGS, 1919-1933  
ALL CORPORATIONS IN THE UNITED STATES<sup>1</sup>  
(in millions of dollars)

(1) YEAR	(2) CORPORATE SAVINGS <sup>2</sup>	(3) DIFFERENCE BETWEEN DEPRECIATION AT COST PRICES AND AT CURRENT PRICES	(4) CORPORATE SAVINGS, MODIFIED (2) + (3)
1919	4,310	-1,000	3,310
1920	1,380	-1,390	- 10
1921	-2,670	- 570	-3,240
1922	1,660	- 290	1,370
1923	2,410	- 640	1,770
1924	1,440	- 490	950
1925	2,810	- 390	2,420
1926	2,180	- 400	1,780
1927	950	- 390	560
1928	2,330	- 290	2,040
1929	1,350	- 380	970
1930	-4,110	- 190	-4,300
1931	-6,040	80	-5,960
1932	-6,550	450	-6,100
1933	-3,060	390	-2,670
Total	-1,610	-5,500	-7,110

<sup>1</sup> Excluding tax-exempt and life insurance companies. The data basic to the figures in columns (2) and (3) are derived from *Statistics of Income*.

<sup>2</sup> Net income less cash dividends paid to individuals. For 1929-33 profits and losses derived from the sale of capital assets have been eliminated.

(3), are given in the last series of figures in the table. At the foot of the table appear algebraic totals for the entire period surveyed. Corporate savings as ordinarily computed reached a total negative figure of 1,610 million dollars, while the modified measures added up to a negative figure of 7,110 million dollars. The cumulated difference, arising out of the discrepancy between original and reproduction cost, amounted to 5,500 million dollars, also negative. The latter figure is very large, in relation to the estimated cumulated corporate savings.

The figures suggest the extent to which business savings tend to be overstated by the use of cost bases in the estimation of depreciation charges when prices are high relatively to preceding periods when investments were made. When prices are relatively low, business savings tend to be understated. We thus see that a considerable fraction of the apparent corporate savings put aside by business organizations during the early part of the 'twenties was required to restore their capital equipment at the relatively high price levels prevailing. The free funds actually available for new investment were smaller than appeared in the income accounts of business enterprises. Where dividends were sustained, at a level equal to that of computed profits, capital was in fact being depleted.<sup>14</sup>

Here we have reflected one factor making for the stimulation of business enterprise when the secular movement

of prices is upward, and the depression of business enterprise when the secular movement of prices is downward. The reason for this phenomenon is found, in part, in the tendency of business men to look to the money counters in which business is transacted as the final criterion and purpose of their activities. When the purchasing power of money becomes the goal and measure of business enterprise, as it may in a runaway inflation, the change in business behavior is great. But inflation must go far before the rules of the game are changed.<sup>15</sup> In the absence of such radical changes the nominal character of money and prices is recognized only sporadically and to a small degree. This occurs, of course, when revaluations of assets are made through appraisal or other less objective estimation. To the extent that business men do in fact recognize the significance of secular changes in price levels, the figures in column (4) of Table 7 represent their estimates of savings. To the extent that they do not, their estimates are those in the second column of the table. Somewhere between these two limits, and probably closer to the figures in column (2), are the entrepreneurial measures of annual savings.

We turn now to another characteristic of business measures of depreciation, already mentioned: their remarkable steadiness. In spite of large fluctuations in gross value of product, physical volume of output, and consequently in the use made of capital equipment, depreciation costs allocated to specific years reveal relatively little change. Cyclical declines in 1921, 1924, 1927, and 1930-32 are definitely impressed even upon annual series of physical output and net income. Gross income declined in 1921 and 1930-32, and rose only fractionally in 1924 and 1927. Depreciation charges, in terms either of original cost or of current replacement cost, reveal no declines at all, except in the most recent period. The averages of the year-to-year changes in the last two series (Table 8) are minor compared with

<sup>14</sup> The same reasoning holds to a great extent where capital consumption is understated not because of the use of the cost base, but because of failure to take obsolescence adequately into account. The situation of the street railways is already history.

It must be noted that the figures in Table 7 refer to the aggregate of all corporations in the United States. If we were to confine our attention to those industries in which depreciation charges bulk large, in comparison with business savings, the influence of price changes would be even greater than is indicated in the table.

<sup>15</sup> Current methods of estimating depreciation charges are but one element in the situation making for stimulus or drag when the secular movement of prices is up or down, and probably not the most important. Lagging wage rates, fixed interest charges, and other costs, must be considered. Even of these other costs, however, the same fundamental reason is at the bottom, namely, the tendency to rely upon money as the ultimate standard of valuation.

TABLE 8  
AVERAGE ABSOLUTE ANNUAL CHANGES IN PHYSICAL OUTPUT, GROSS AND NET INCOME, AND DEPRECIATION CHARGES, 1919-1933  
ALL CORPORATIONS IN THE UNITED STATES<sup>1</sup>

	As a percentage of 1919-33 average value	1929 value
Physical volume of output	10.9	8.5
Gross income	11.8	8.8
Depreciation charges		
Expressed in original cost prices	6.8	5.4
Expressed in 1929 prices	4.9	4.0
Net income	60.0	30.7

<sup>1</sup> The index of physical volume of output covers industrial production and trade. It is computed by Persons and Foster, *Review of Economic Statistics*, August 15, 1933, p. 155. The 1933 figure is estimated.

Gross income does not include tax-exempt income. The original data are from *Statistics of Income*.

The depreciation charges are also from *Statistics of Income*. They were expressed in 1929 prices by dividing by the index on the first line of Appendix Table II.

The net income is based on compiled net profits after taxes, excluding dividends received from other corporations and gains or losses on the sale of capital assets (*Statistics of Income*).

those of the other series, and are due primarily to the secular movement, rather than to the cyclical fluctuations.

Since the estimates of net income are remainders after depreciation (among other items) has been subtracted from gross income, their violent fluctuations are to be ascribed, in part at least, to the absence of large movements in depreciation charges. And this is a consequence of the widely prevalent use of the straight-line depreciation formula or other formulae not taking directly into account fluctuations in the volume of output. Here, also, the use of this particular type of formula, rather than of one that would make depreciation charges reflect the rate of production, appears to be explained chiefly by the limited visibility available to business men. The longevity of a machine or a building may be more readily and accurately predicted than the use, in terms of volume of output, that will be made of it. Another, though minor, contributing factor may be the habit in many business computations of working with rough magnitudes. This, in turn, may be a consequence of the relatively large cost inherent in fine measurements, or of the factor already mentioned—the belief that more accurate measures are impossible.

A further factor may be the continuous decay which to some extent goes on in capital goods whether they be used or not. But to the extent that the loss of value of capital goods is not simply a function of time, the straight-line method of allocating depreciation charges appears to be rigid in its lack of discrimination among time periods with varying volumes of output. Similarly, to the extent that the loss of value is directly related to the volume of output, the maintenance method used by many public utilities is too elastic, resulting in charges for maintaining capital that are of greater cyclical amplitude than is output (see Table 2).

#### CONCLUDING REMARKS

In this *Bulletin* we have been concerned chiefly with the available data on capital consumption, and with some of their characteristics. We have tried to indicate the reservations that must be made in using these materials, and have called attention particularly to the ambiguities resulting from changing prices. The relation of estimates of capital consumption to the measurement of profits and of corporate savings was indicated.

An attempt to learn what we can about the negative items in the nation's capital account involves more than the compilation of measures of their extent and fluctuation. The nature of the estimates themselves must be considered, for we must resort to business computations for our figures. Even if the consumption of capital is an objective fact, we become aware of it only through the minds of those who keep the records. These records are, further, influenced by efforts to control profit estimates and by other factors.

It is essential to note this fact that all measures of capital consumption are estimates. We do not know how to handle efficiently the problem of measuring capital consumption in a dynamic world. Technological and price changes 'disturb' business computations and forecasts, as well as judgments concerning the past. Reluctance to acknowledge specific instances of capital evanescence is common. The factors that make for profits make also for difficulty in the computation of profits and all related estimates. In the complex changing situation business men cannot see far enough, or clearly enough. It is partly for this reason that they tend to hold fast to the unchanging reality of cost prices, and it may be partly for this reason that waves of optimism and pessimism tend periodically to sweep over business enterprise.

#### FORTHCOMING PUBLICATIONS

The third *Bulletin* of the 1936 series, to be issued this summer, will be by Wesley C. Mitchell: *Characteristics of the Business Cycle, 1927-1933*.

Chapter III of Dr. Mitchell's second volume—*Business Cycles: Analysis of Cyclical Behavior*—has been mimeographed and is ready for distribution. Copies will be sent to all who have already purchased Chapters I and II. We still have a few copies of the first two chapters, and the three will be sent upon receipt of \$1.00.

*Ebb and Flow in Trade Unionism*, in which Dr. Leo Wolman gives trade union membership from 1897 to date and discusses events since his volume, *The Growth of American Trade Unions, 1880-1923*, appeared, will be published next month (300 pp., 5 charts, 48 tables, price \$3.00). Orders are being taken now. Some copies of the former volume are still available. As long as the supply lasts the two volumes may be purchased for \$4.00.

APPENDIX TABLE I

ACCOUNTING MEASURES OF BUSINESS CAPITAL CONSUMPTION, 1919-1933, BY TYPE AND INDUSTRY<sup>1</sup>

(in millions of dollars)

	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
<i>Agriculture and related industries</i>															
Depreciation							923	916	921	921	940	919	870	831	786
Depletion							23	24	22	22	25	17	12	8	10
Depreciation and depletion	1,020	1,083	957	888	878	896	946	940	943	943	965	937	882	838	796
<i>Mining</i>															
Depreciation							295	245	242	216	239	203	203	173	160
Depletion							297	289	242	222	254	191	113	106	119
Depreciation and depletion	508	613	542	584	705	687	592	534	484	439	492	394	316	280	279
Development expense	334	495	286	312	392	338	351	373	322	304	321	260	173	134	139
<i>Manufacturing</i>															
Depreciation							1,493	1,640	1,718	1,795	1,879	1,945	1,849	1,681	1,631
Depletion							156	263	244	268	277	249	126	121	114
Depreciation and depletion	1,152	1,293	1,287	1,485	1,573	1,552	1,649	1,903	1,962	2,063	2,156	2,194	1,974	1,802	1,745
<i>Other industries (trade, construction, service, miscellaneous)</i>															
Depreciation							741	970	848	938	1,033	1,058	1,049	1,029	920
Depletion							28	6	6	10	6	5	14	4	3
Depreciation and depletion	475	521	568	594	630	678	769	976	854	948	1,039	1,063	1,063	1,033	923
<i>Public utilities and transportation</i>															
Depreciation							588	720	794	898	983	1,023	1,123	1,062	996
Depletion							8	24	21	25	29	27	23	22	15
Depreciation and depletion	369	337	436	455	497	534	596	745	814	923	1,011	1,049	1,146	1,084	1,012
Repairs, renewals and maintenance	2,318	3,016	2,358	2,315	2,616	2,389	2,408	2,501	2,436	2,355	2,416	2,080	1,658	1,222	1,171
Retirements (loss on retired property and delayed income debits), steam railroads	11	10	30	52	66	49	54	59	61	50	86	90	105	63	115
<i>Finance and real estate (non-residential)</i>															
Depreciation							467	559	582	654	710	701	687	636	650
Depletion							12	8	5	8	6	4	3	2	2
Depreciation and depletion	263	297	307	378	364	428	479	567	587	662	716	706	690	638	652
Major repairs and alterations	271	289	348	367	445	373	290	340	440	380	490	362	288	143	145
<i>Unallocated</i>															
Fire losses	126	176	195	200	211	216	220	221	186	183	181	198	178	158	106

<sup>1</sup> The data on business depreciation and depletion are based on corporate figures published in *Statistics of Income*. For farming, estimates of the Department of Agriculture were used, with several minor modifications. Non-corporate figures were estimated by stepping up the corporate figures by ratios obtained from the Censuses of Manufactures, Mines, Distribution, and Construction. Separate data for depreciation and depletion are not available for years prior to 1925.

The figures on repairs, renewals and maintenance by public utilities were collected from *Statistics of Railways*, the Census of Electrical Industries, and estimates of the Federal Employment Stabilization Board, interpolated by data published in several industrial journals and corporate reports. Retirements of equipment by steam railways are also from *Statistics of Railways*. Major repairs and alterations in the real estate field (and also of homes) are based on figures relating to permits published in the *Monthly Labor Review*, supplemented by data from the Bureau of Labor Statistics.

Development expenses in mining industries are derived from data in the Census of Mines and Quarries, *Report on Crude Petroleum and Its Liquid Refined Products* (U. S. Tariff Commission), and *Preliminary Report on a Survey of Crude Petroleum* (Department of the Interior); with interpolations based on *Mineral Resources* (Bureau of Mines).

Total fire losses are estimated by the National Board of Fire Underwriters. To these was applied a percentage based on the ratio of value of business capital goods to the total national wealth subject to fire hazards (Federal Trade Commission estimates of national wealth, 1922).

APPENDIX TABLE II

INDEXES USED IN DEFLATING ACCOUNTING MEASURES OF BUSINESS CAPITAL CONSUMPTION, 1919-1933<sup>1</sup>

(prices in 1929=100)

	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
Depreciation <sup>2</sup>	70.8	77.0	81.4	82.9	84.2	85.7	86.9	88.0	89.2	90.2	91.1	91.9	92.1	91.9	91.2
Repairs, renewals and maintenance <sup>3</sup>	116.4	135.6	102.6	91.8	105.4	101.7	98.0	98.3	99.9	97.5	100.0	97.6	89.6	81.5	80.0
Development expense <sup>4</sup>	114.5	132.2	102.5	92.7	104.7	101.4	98.7	98.7	99.6	97.5	100.0	96.2	90.3	80.8	81.0
Fire losses															

<sup>1</sup> Depletion charges expressed in constant prices were obtained directly, without use of a price index; see explanation in the text.

<sup>2</sup> This is an harmonic mean of various indexes of the prices of capital equipment, weighted by the amount of depreciation charges based on each year's price. In 1929, for example, depreciation was charged on equipment and buildings purchased in 1929, 1928, 1927, and so on. The deflator for 1929 depreciation charges must therefore be a weighted average of 1929, 1928, 1927, ..... prices, the weights being the 1929 depreciation on the goods purchased in each of these years. This weighted average, relative to 1929 prices, is 91.1. To express the 1929 depreciation charges in terms of 1929 prices, it is necessary to divide the charges by this average, 91.1. The various underlying price indexes include the following: Railroad construction costs (Interstate Commerce Commission), machine tools and wood-

APPENDIX TABLE III

## MEASURES OF CAPITAL CONSUMPTION, RESIDENCES, AND RELATED PRICE INDEXES, 1919-1933

1919 1920 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933

A. ACCOUNTING MEASURES OF CAPITAL CONSUMPTION (in millions of dollars) <sup>1</sup>															
RESIDENCES, RENTED															
<i>Non-farm</i>															
Depreciation	266	278	294	326	371	421	476	532	579	619	651	673	682	684	682
Major repairs and alterations	89	93	111	114	135	110	83	93	111	109	99	62	41	28	32
<i>Farm</i>															
Depreciation	28	31	23	24	24	24	24	25	25	25	25	25	22	20	20
RESIDENCES, OWNER-OCCUPIED															
<i>Non-farm</i>															
Depreciation	232	249	269	304	355	413	478	547	608	666	717	741	750	753	751
Major repairs and alterations	99	108	131	138	168	140	109	126	155	155	145	90	60	40	47
<i>Farm</i>															
Depreciation	395	428	326	333	334	333	342	344	348	344	349	342	307	284	284
UNALLOCATED															
Fire losses	63	89	98	99	105	108	111	111	94	92	91	99	89	79	53
ALL RESIDENCES															
Depreciation	921	986	912	987	1,084	1,191	1,320	1,448	1,560	1,654	1,742	1,781	1,761	1,741	1,737
Major repairs and alterations	188	201	242	252	303	250	192	219	266	264	244	152	101	68	79
Fire losses	63	89	98	99	105	108	111	111	94	92	91	99	89	79	53
Total	1,172	1,276	1,252	1,338	1,492	1,549	1,623	1,778	1,920	2,010	2,077	2,032	1,951	1,888	1,869
B. INDEXES USED IN DEFLATING ACCOUNTING MEASURES OF CAPITAL CONSUMPTION (prices in 1929=100)															
ALL RESIDENCES															
Depreciation <sup>2</sup>	43.4	45.1	47.1	49.9	53.5	57.5	61.3	64.7	67.4	69.7	71.6	72.9	73.9	74.6	75.2
Major repairs and alterations <sup>3</sup>	95.9	121.4	97.5	84.3	103.4	104.1	99.9	100.5	99.6	99.9	100.0	98.0	87.6	75.8	82.2
Fire losses															
C. MEASURES OF CAPITAL CONSUMPTION, IN TERMS OF 1929 PRICES (in millions of dollars) <sup>4</sup>															
ALL RESIDENCES															
Depreciation	2,122	2,186	1,936	1,978	2,026	2,071	2,153	2,238	2,314	2,373	2,433	2,443	2,383	2,334	2,310
Major repairs and alterations	196	166	248	299	293	240	192	218	267	264	244	155	115	90	96
Fire losses	66	73	101	117	102	104	111	110	94	92	91	101	102	104	64
Total	2,384	2,425	2,285	2,394	2,421	2,415	2,456	2,566	2,675	2,729	2,768	2,699	2,600	2,528	2,470

<sup>1</sup> The depreciation charges are accounting measures in the sense that they are computed in accordance with ordinary accounting practice: it is doubtful whether most owners of private residences make formal estimates of depreciation. Depreciation charges on farm homes are based on figures of the Department of Agriculture and the Census of Agriculture. Depreciation on non-farm residences are estimates derived from the value of owned homes and rentals paid in 1930 (Census of Population); new construction of residences (permits published in the *Monthly Labor Review*, contracts awarded compiled by the F. W. Dodge Corporation, and permits compiled by J. R. Riggleman); rents paid and received by corporations (*Statistics of Income*); rents paid by wage earners (*Monthly Labor Review*); ratio of depreciation charges to rentals received by realty corporations (Bureau of Internal Revenue, unpublished figures); and depreciation rates listed by the Treasury Department (*Depreciation Studies—Preliminary Report of the Bureau of Internal Revenue, 1931*).

Major repairs and alterations of homes are based on building permits published in the *Monthly Labor Review*, supplemented by unpublished data from the Bureau of Labor Statistics.

Total fire losses are estimated by the National Board of Fire Underwriters. To these was applied a percentage based on the ratio of value of residences to the total national wealth subject to fire hazards (Federal Trade Commission estimates of national wealth, 1922).

<sup>2</sup> Obtained by a procedure similar to that outlined in footnote 1 of Appendix Table II. The basic underlying cost index was that of the *Engineering News-Record*. In this case it was necessary to use prices of years preceding 1913.

<sup>3</sup> Index of building costs, *Engineering News-Record*.

<sup>4</sup> Derived by dividing the figures in Section A by the appropriate price indexes in Section B.

(Notes to Appendix Table II continued)

working machinery (American Appraisal Company), commercial cost of cars (Brill), processed capital equipment (National Bureau of Economic Research), construction costs (American Appraisal Company, Richey, Tuttle). Owing to certain provisions in the income tax law, it is not necessary to use prices prior to 1913.

The weights were obtained from estimates of gross capital formation (*Bulletin 52*, National Bureau of Economic Research; *Census of Manufactures*, U. S., Massachusetts, and Pennsylvania, and volume of construction, Dodge Co. and Riggleman) and the depreciation rates listed by the Bureau of Internal Revenue.

<sup>3</sup> Weighted arithmetic average of five indexes of per unit maintenance costs: steam railroads—ways and structures (I.C.C.), steam railroads—equipment (I.C.C.), electric light and power costs (Richey), electric cars (Brill), construction (American Appraisal Company).

<sup>4</sup> Weighted arithmetic average of the indexes listed in footnote 2.