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GROWTH AND DEPRECIATION

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ABSTRACT OF PAPER

It is generally assumed that a complex utility property will depreciate to an approximately fixed per cent condition. This is shown by theoretical and actual curves to be incorrect. It is shown that the manner of the company's growth affects its per cent condition.

The necessity for reserves, the manner in which they may be kept and the return which should be allowed on them, whether reinvested or not, is discussed. Several Commission and Court decisions are quoted to show the tendency to disallow a return on a reserve and arguments are presented in refutation of the decisions.

The principal points are as follows:

1. The condition of a property is dependent not only on maintenance but also on its growth.
 2. Property does not settle down to a fixed per cent condition.
 3. Capital is kept intact by reinvesting reserve in extensions. Under this condition, depreciated value of the entire property is the fair one for rate making purposes.
 4. For a company unable to use reserve in extensions a liquid depreciation fund will be necessary.
 5. The same return, available for dividends, should be allowed on a reserve as on the remainder of the property.
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IN THIS article the writer tries to bring out the following points:

First, to show that the per cent condition of any property is dependent not only upon the maintenance but upon the past and present growth.

Second, to show that under practically no condition will it be necessary to bring a property back to one hundred per cent condition, but that it does not settle down to some fixed per cent condition less than one hundred per cent. It does, however, go through a repeating cycle of conditions, one point in the cycle being a maximum above which it will never rise. This maximum point will depend entirely upon the growth of the property and should be studied separately for each property under consideration.

Third, to show that under certain conditions of growth, a

growing company need keep no liquid depreciation reserve fund; that it may reinvest the reserve in extensions, making renewals as they come due in any given year, from the amount set aside for depreciation reserve in that year, and that by so doing the stockholders' capital is kept intact, yet the depreciated value of the whole property is the fair **one**, both for consumer and stockholder, for rate-making purposes.

Fourth, to show that for a company which has stopped growing or for one which is growing at a rate not large enough to use all of the depreciation reserve for reinvestment in extensions, it will be necessary to have a continually varying amount in a liquid depreciation reserve fund, and that this amount will fluctuate in a manner depending upon the company's growth.

Fifth, to show that since such a liquid reserve may be necessary for a growing company and will be necessary for a company which has ceased to grow, that the same return should be allowed on such a reserve as on any other capital invested in the property, and that such return should be available for dividends, provided that the cost new, less depreciation, is to be used as a basis for making the rates.

The following definitions and assumptions are made in the discussion. By liquid depreciation reserve fund is meant a reserve either as cash in a bank, invested in bonds or employed in any other way so as to be readily convertible into cash for immediate use. This is to distinguish it from depreciation reserve, which is invested in extensions and betterments and which cannot be readily turned into available cash. No consideration is taken of scrap value nor of a reserve for emergencies or catastrophies as the calculations are not in any way affected by such a fund, the effect being simply to refer them to a different ordinate. All calculations are on the straight line basis and all properties considered are assumed to be kept in the best state of repair. It is assumed that the depreciated value of the property will be used as a basis for making the rates.

Before attempting to draw any conclusions from the tables, it is advisable to show how they were constructed and calculated. Table I is the calculation for a property in which a uniform capital investment of \$1000 a year is made for ten years and the property then stops growing. All the elements of the property are assumed to have a ten year life. Table II shows a property similar in all respects but one, to that shown in Table I. In Table II the uniform investment is made for only five years of

the ten. Table III is for a property the elements of which have a ten year life. In the first year the capital investment is \$1000. In the second year the depreciation fund is used for

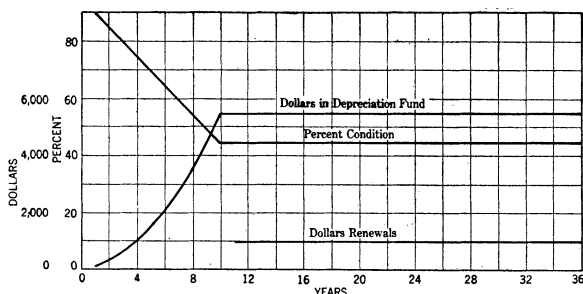
TABLE I.
UNIFORM YEARLY INVESTMENT FOR TEN YEARS

End of Growth—Tenth Year

Life—Ten Years

Depreciation reserve not invested in extensions

End of year	Capital invest. for the year	Total capital expenditures	Increment to Depr. fund	Deduction from depr. fund	Total in depr. fund	Percent condition
1	1000	1,000	100	0	100	90
2	1000	2,000	200	0	300	85
3	1000	3,000	300	0	600	80
4	1000	4,000	400	0	1000	75
5	1000	5,000	500	0	1500	70
6	1000	6,000	600	0	2100	65
7	1000	7,000	700	0	2800	60
8	1000	8,000	800	0	3600	55
9	1000	9,000	900	0	4500	50
10	1000	10,000	1000	0	5500	45
11	—	10,000	1000	1000	5500	45
12	—	10,000	1000	1000	5500	45
13	—	10,000	1000	1000	5500	45
14	—	10,000	1000	1000	5500	45
15	—	10,000	1000	1000	5500	45
16	—	10,000	1000	1000	5500	45
17	—	10,000	1000	1000	5500	45
18	—	10,000	1000	1000	5500	45
19	—	10,000	1000	1000	5500	45
20	—	10,000	1000	1000	5500	45



CURVE I—UNIFORM INVESTMENT FOR TEN YEARS

End of growth, tenth year—life, ten years—depreciation reserve not invested in extensions.

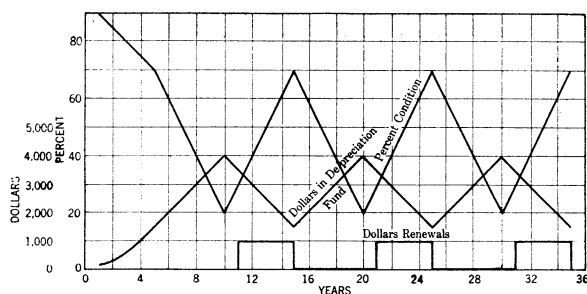
investment in extensions and enough additional capital is invested to bring the investment of both capital and reserve for the year, up to \$1000. The same procedure is followed each

year until at the end of the tenth year the property ceases to have any further additions. Table IV is for a property the elements of which have a ten year life. Starting with an invest-

TABLE II.

Uniform yearly investment for five years
End of growth—fifth year
Life—ten years
Depreciation reserve not invested in extensions

End of year	Capital invest. for the year	Total capital expenditures	Increment to depr. fund	Deduction from depr. fund	Total in depr. fund	Percent condition
1	1000	1000	100	0	100	90
2	1000	2000	200	0	300	85
3	1000	3000	300	0	600	80
4	1000	4000	400	0	1000	75
5	1000	5000	500	0	1500	70
6	—	5000	500	0	2000	60
7	—	5000	500	0	2500	50
8	—	5000	500	0	3000	40
9	—	5000	500	0	3500	30
10	—	5000	500	0	4000	20
11	—	5000	500	1000	3500	30
12	—	5000	500	1000	3000	40
13	—	5000	500	1000	2500	50
14	—	5000	500	1000	2000	60
15	—	5000	500	1000	1500	70
16	—	5000	500	0	2000	60
17	—	5000	500	0	2500	50
18	—	5000	500	0	3000	40
19	—	5000	500	0	3500	30
20	—	5000	500	0	4000	20



CURVE II—UNIFORM YEARLY INVESTMENT FOR FIVE YEARS

End of growth, fifth year—life, ten years—depreciation reserve not invested in extensions.

ment of \$1000 the first year, the investment decreases one hundred dollars per year until the tenth year, at which time the property stops growing. The depreciation reserve is not re-

TABLE III.

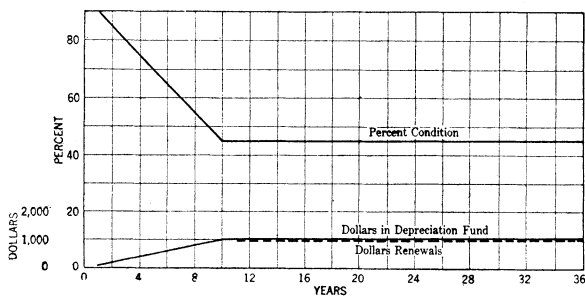
Uniform yearly investment for ten years

End of growth—tenth year

Life—ten years

Depreciation reserve invested in extensions

End of year	Capital Invest. for the year	Total capital expenditure	Investment for the year from depr. reserve	Total investment capital plus reserve	Increment to depr. fund	Deduction from depr. fund	Total in depr. fund	Percent condition
1	1000	1000	—	1,000	100	—	100	90
2	900	1900	100	2,000	200	100	200	85
3	800	2700	200	3,000	300	200	300	80
4	700	3400	300	4,000	400	300	400	75
5	600	4000	400	5,000	500	400	500	70
6	500	4500	500	6,000	600	500	600	65
7	400	4900	600	7,000	700	600	700	60
8	300	5200	700	8,000	800	700	800	55
9	200	5400	800	9,000	900	800	900	50
10	100	5500	900	10,000	1000	900	1000	45
11	—	5500	—	10,000	1000	1000	1000	45
12	—	5500	—	10,000	1000	1000	1000	45
13	—	5500	—	10,000	1000	1000	1000	45
14	—	5500	—	10,000	1000	1000	1000	45
15	—	5500	—	10,000	1000	1000	1000	45
16	—	5500	—	10,000	1000	1000	1000	45
17	—	5500	—	10,000	1000	1000	1000	45
18	—	5500	—	10,000	1000	1000	1000	45
19	—	5500	—	10,000	1000	1000	1000	45
20	—	5500	—	10,000	1000	1000	1000	45



CURVE III—UNIFORM YEARLY INVESTMENT FOR TEN YEARS

End of growth, tenth year—life, ten years—depreciation reserve invested in extensions.

invested. Table V shows a property consisting of two life groups having lives of ten and twenty years respectively. Starting with a capital investment of five hundred dollars for each of

TABLE IV.

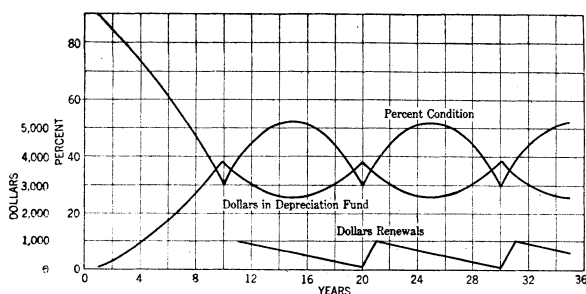
Decreasing yearly investment for ten years

End of growth—tenth year

Life—ten years

Depreciation reserve not invested in extensions

End of year	Capital invest for the year	Total capital expenditure	Increment to depr. fund	Deduction from depr. fund	Total in depr. fund	Depreciated value of property	Percent condition
1	1000	1000	100	—	100	900	90.0
2	900	1900	190	—	290	1610	84.6
3	800	2700	270	—	560	2140	78.3
4	700	3400	340	—	900	2500	73.6
5	600	4000	400	—	1300	2700	67.5
6	500	4500	450	—	1750	2750	61.0
7	400	4900	490	—	2240	2660	54.3
8	300	5200	520	—	2760	2440	47.0
9	200	5400	540	—	3300	2100	38.9
10	100	5500	550	—	3850	1650	30.0
11	—	5500	550	1000	3400	2100	38.2
12	—	5500	550	900	3050	2450	44.5
13	—	5500	550	800	2800	2700	49.1
14	—	5500	550	700	2650	2850	51.7
15	—	5500	550	600	2600	2900	52.8
16	—	5500	550	500	2650	2850	51.7
17	—	5500	550	400	2800	2700	49.1
18	—	5500	550	300	3050	2450	44.5
19	—	5500	550	200	3400	2100	38.2
20	—	5500	550	100	3850	1650	30.0



CURVE IV—DECREASING YEARLY INVESTMENT FOR TEN YEARS

End of growth, tenth year—life, ten years—depreciation reserve not invested in extensions.

the groups, the capital investment is increased one hundred dollars a year for each group for the ten years. In each year an equal amount has been reinvested in each life group, so that the

total of such investments for any given year is nearly equal to the amount set aside in the depreciation reserve the year before. This continues up to and including the tenth year after which time further investments are discontinued, but renewals are made as each portion of the original investment reaches the end of its life.

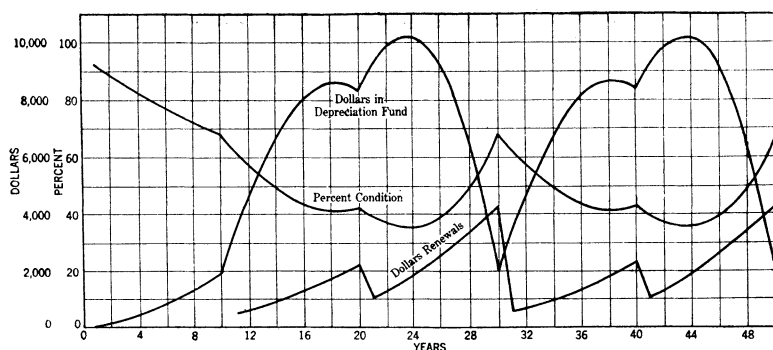
It may be well here to point out something worthy of note which developed in the course of the calculation. It will be seen, by reference to Table V, that in every case, the sum of the dollars remaining in the fund (column 15) and the depreciated value of the property (column 17) giving (column 18) the total value of the property, is the same as the total capital expenditure (column 6). This furnishes a short method of calculating the depreciated value of the property *i.e.* by subtraction instead of by the depreciation of each year group. Take for example the tenth year: the long method is:—

Dollars	Per cent remaining value	Dollars remaining value
500	0	0.00
500	50	250.00
630	10	63.00
630	55	346.50
790	20	158.00
790	60	474.00
940	30	282.00
940	65	611.00
1100	40	440.00
1100	70	770.00
1300	50	650.00
1300	75	975.00
1500	60	900.00
1500	80	1200.00
1700	70	1190.00
1700	85	1445.00
1950	80	1560.00
1950	90	1755.00
2150	90	1935.00
2150	95	2042.50
		<hr/>
		\$17,047.00

This \$17,047, the depreciated value of the property, as obtained above, plus \$1953, the dollars in the depreciation fund, is equal to the total capital expenditure of \$19,000. The short method is therefore, to subtract the dollars in the depreciation

fund from the total capital expenditure to get the depreciated value of the property. This method was followed in the calculation of the table.

It is generally considered that a property maintained in good operating condition will be between 70 and 85 per cent new. In fact, Whitten, in his *Valuation of Public Service Corporations*, discussing depreciation says, (Vol. I, page 358, par. 421) "It has been stated that a street railway maintained in good operating condition will necessarily show cost less depreciation of from 70 to 85 per cent of the cost new". That this is an entirely fallacious assumption and that the percent condition of any property is not only a function of its maintenance, but also



CURVE V—INCREASING YEARLY INVESTMENT FOR TEN YEARS

Life { one group, ten years
one group, twenty years

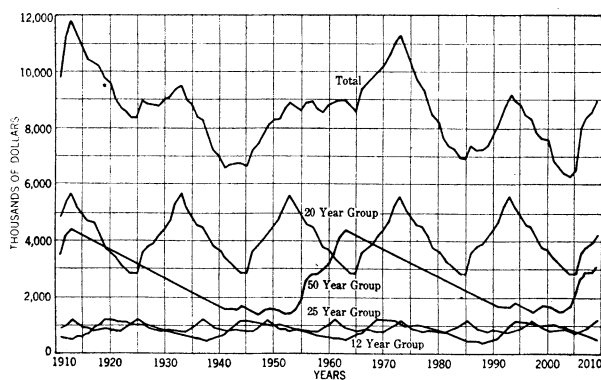
End of growth, tenth year—depreciation reserve invested in extensions.

most decidedly of the manner of its growth, is shown by the accompanying tables and curves.

It is now an easy matter to prove that Mr. Whitten's assumption is wrong, and also to prove the first point, which is that the per cent condition of any property is dependent not only on the maintenance, but upon the past and present growth. Referring to the tables, we see that in Table I and Curve I, where there has been a uniform investment over a term of years corresponding to the life of the property, the per cent condition varies from 90 to 45 during that term, and then stays at 45 when the property stops growing. The per cent condition appears as 45 instead of the proverbial 50 because, in the calculations, the end, instead of the beginning of the tenth year is considered. In Table II and Curve II, where there is a uniform investment

over a term of years not corresponding to the life of the property, the per cent condition varies from 90 to 70, while the property is growing. After that it varies in repeating cycles from 70 to 20 and back to 70 again. This, of course, is an extreme case, but it shows the possibilities of variation. Table III and Curve III show the same characteristics as Table I, although in Table I there is no reinvestment of reserve, while in Table III there is. Table IV and Curve IV show a more complicated property than the others. Here the variation during the ten years the property is expanding, is from about 92 to about 67. It then goes through a repeating cycle whose period is twenty years, varying from 67 to 35 per cent and back again.

Thus it may readily be seen that a company which grows at an



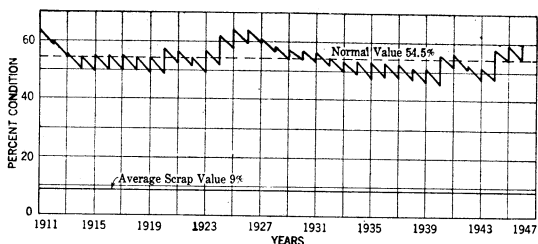
CURVE VI—DEPRECIATED SERVICE VALUES OF AN ACTUAL PROPERTY

End of growth assumed Dec. 31, 1913—original service value \$16,500,000—maximum per cent condition 69.0 per cent—minimum per cent condition 37.5 per cent.

increasing rate will have a lower per cent depreciation in any given year, than a company which grows at a uniform rate, all other conditions being assumed the same. Furthermore, if both companies reach their maximum growth at the same time, thereafter their per cent condition will vary one from the other; first, because of the discrepancies between the terms over which the investments have been made and the life terms of the groups (compare Tables and Curves I and III) and second, because of the dissimilar manner in which the investments have been made (compare Tables and Curves IV and V).

Moreover this is borne out not only by the theoretical calculation, but Curve VI shows this condition for an actual electric property. The company was assumed to have reached its final

growth on December 31st, 1913 after which date only renewals were made. The total service value of all the property was approximately \$16,500,000 yet it may be seen from the curve that the actual service value varies from \$6,200,000 to \$11,000,000 or from 37.5 per cent to 69 per cent. Now, even supposing that some of the assumptions as to probable life are incorrect, the property will still vary over a wide range and not be in any popularly supposed fixed condition somewhere between 70 and 85 per cent. Curve VIII is for another actual property but a much smaller one than that considered in Curve VI. The property is assumed to reach its full growth in 1912, and the remaining service value is shown for the next 53 years. The service value varies from \$810,000 to \$370,000 or a corresponding per cent variation from 77 to 35.



CURVE VII—TOTAL COMPOSITE THEORETICAL VALUE CURVE OF THE DEPRECIABLE PROPERTY OF THE UNITED RAILWAYS CO. OF ST. LOUIS AS GIVEN IN THE REPORT ON THAT PROPERTY BY THE ST. LOUIS PUBLIC SERVICE COMMISSION—1912

Before passing to point two, it is pertinent to quote again from Whitten, who says, (Vol. 2, page 1127, par. 1285). "We know, however, that there is a tendency for all utilities to settle down after a time to a more or less uniform condition as regards the percentage amount of accrued depreciation, and the annual requirements for renewals and replacements. After the various parts of a large public utility plant have gone through complete cycles of renewals, the plant settles down to a condition in which, saving extraordinary functional depreciation, expenditures for maintenance, repairs and renewals become practically constant. There is little fluctuation from year to year and the averages by five or ten year periods are practically identical. This settling down or equalizing process, is very greatly hastened by the fact that all large systems are constructed piecemeal."

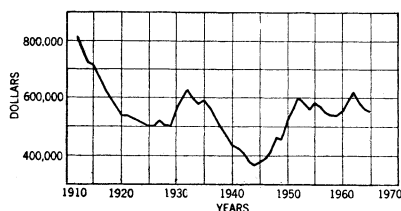
The above theory, which the writer has tried to refute, is

also supported by Mr. James E. Allison, Chief Engineer of the St. Louis Public Service Commission, who in the report on the United Railways Company of St. Louis, presents the curve which is here reproduced as Curve VII. He says, (Appendix A, page 89):

"It has been the purpose of the writer to show by diagrams that piecemeal built properties of any complexity, will eventually assume a theoretical value curve, closely conforming to the straight normal value line, halfway between 100 per cent and the composite scrap value of the property."

It cannot be denied that the curve which he gives most certainly is a uniform curve and tends to support his theory. It should be noted though, that even his curve varies over a range of 15 per cent during the comparatively short time of 13 years, and although 15 per cent is small, it takes a different

aspect when considered as 15 per cent of \$30,000,000, the approximate value of the property, or \$4,500,000.



CURVE VIII—DEPRECIATED SERVICE VALUES OF AN ACTUAL PROPERTY

End of growth assumed Dec. 31, 1912—original service value \$1,056,917—maximum per cent condition 77.0 per cent—minimum per cent condition 35.0 per cent.

As previously stated, the curve shown by Mr. Allison, is a remarkably smooth one, but when compared to Curves VI and VIII, it shows the danger of drawing a general conclusion from any one curve. Every complex prop-

erty undoubtedly displays the tendency which Mr. Allison points out, but it would be decidedly unsafe to apply it indiscriminately to any property. The point is that each property should be investigated separately to determine its characteristics in this respect.

The second point, to show that under practically no condition will it be necessary to bring a property back to 100 per cent condition, has already been presented by many other writers, but it is given here again in conjunction with the conclusion from point number one. It is obvious that any property which has been built up gradually and not all at once, will have its various parts wear out in a similar sequence to that in which they were installed. Since different portions of the property will have to be replaced each year, it will never be necessary to replace all of them at once and so bring the property back to one hundred per cent condition.

As far as the point just made goes, most writers are agreed, but having reached that conclusion they claim that the property remains at a certain fixed condition, the exact per cent depending on the maintenance.

It is perfectly true that the entire property will not have to be renewed at any one time but only in the condition where there has been a uniform growth over a term of years corresponding to the life of the property (see Table I and Curve I) will the property reach a fixed condition and remain there after the property has stopped growing. Also, as long as a property is growing whether uniformly or otherwise, there will be a variation in its per cent condition. In other words, there is an obligation to renew varying amounts of property in different years in the future, and any calculation of reserves based on an assumption that because of perpetual life the company will reach a stable condition either during or after its growth is entirely incorrect.

It will be noticed from an examination of the tables that while the property is growing, the per cent condition is decreasing, the rate of decrease varying inversely with the rate of growth. When the property stops growing it has reached a certain per cent condition and thereafter it varies between that condition and some other, dependent upon the manner of growth. When the growth stops the property may be at a minimum per cent condition, as in Table IV and Curve IV, where there has been a decreasing rate of growth; or at a maximum as in Table V and Curve V where there has been an increasing rate of growth. Table IV and Curve IV show that the property will vary between 30 and 53 per cent, while Table V and Curve V show, in that case, a variation of from 35 to 68 per cent.

From the above figures it is evident that each property, should it stop growing, will go through a cycle in which it reaches a certain maximum condition less than 100 per cent, this maximum condition being entirely dependent on the manner of the property's growth.

It may be argued that the writer has made arbitrary and special assumptions in taking cases where the period of growth corresponds to the life of the property, but both Tables II and V are based on other assumptions. Besides this, it is worth bearing in mind that any property may be divided into a series of groups in which the investment term corresponds to the life term, and that each of these groups will follow a condition curve of its own. For a complex property, therefor, there would be

a series of such curves which would give a resultant one. This resultant curve, however, would also vary over a considerable range. This is borne out by Curves VI and VIII of actual properties.

Since it will never be necessary to renew the entire property, some of the reserve necessary to return it to the 100 per cent condition may be dispensed with. It is not correct, however, to say that since the reserve will never be needed it should not be obtained. The stockholder has a right to expect that his capital be kept intact at 100 per cent. How then is the reserve to be handled? This is taken up as the third point.

There are three conditions which may be used as divisions for the consideration of the laying aside and use of depreciation reserve. These are:

1. Company growing at the great enough rate to permit the investment of all the reserve in extensions.
2. A company not growing at a great enough rate to permit the investment of all the reserve in extensions.
3. A company which is not growing.

Take the first case, where a company is growing at a great enough rate to permit the investment of all the reserve in extensions. It is clear that the annual charge for depreciation will, in some years be less, and in some years more, than the cost of renewals. In those years that the cost of renewals is less than the charge for depreciation, the difference may be invested in extensions, and in those years in which the cost of renewals is greater than the depreciation charge, it will be necessary to issue securities with the extensions made from reserve as a basis, using the money from the securities for the renewals. The securities, however, should not be issued to an amount greater than the depreciated value of the extensions. Wherever the depreciation reserve is invested in extensions, it is necessary to keep a careful record of property of this class. It is essential that separate accounts be kept for capital investment and reserve investment. The trouble in the past was that no attempt was made to keep them separate.

In the second case, where the company is not growing at a great enough rate to permit the investment in extensions of the difference between depreciation charge for the year and renewals for the year, and in the third case where the company has stopped growing, it will be necessary to keep the surplus of annual allowance over cost of renewal for certain years, in a liquid

reserve fund, so as to be able to make up the deficiencies in other years. That some money must be so kept is now clear, for point one shows the wide fluctuations in per cent condition and in yearly renewals. How much must be so kept will be discussed under point four.

At present it is interesting to consider in what years the peak demands, requiring a security issue for the first case and a withdrawal of money from the liquid reserve in the second and third cases, will fall. In any complex property there are groups of things having different costs and different lives installed in the same and different years. If the cost is considered as amplitude, the lives as frequency, and the years as phase displacement it may readily be seen that as different waves come into step and pass out again, peaks and valleys will occur. In order to determine the variation in renewal charges it will be necessary to make tables and plot curves of the future renewals in each group. These curves will take the same general form as those in Curve VI, but will be for total replacement costs, instead of remaining service value as shown there. If tables are once compiled it is a simple matter to change them yearly as further extensions are made in the various groups. By following such a plan it will be easy to see whether or not adequate provision is being made for the handling of future extensions and to predict in what years it will be necessary to issue securities.

As described in the introduction, the second portion of point three is to show that by reinvesting depreciation reserve in extensions, the stockholders' capital is kept intact, yet the depreciated value of the property is the fair one for rate making purposes both from the point of view of the consumer and the stockholder.

Table V is for a property in which the depreciation reserve is invested in extensions. Let us consider the tenth year. Here the total expenditure on the property both from capital and reserve is \$25,120, which has depreciated to \$17,047. This latter sum plus \$1953, which has been accumulated in the depreciation reserve during the past year and which as yet could not be reinvested, gives \$19,000 the capital expenditure. Therefore, with the exception of the amount (\$1953) accumulated in the reserve fund during the current year and not yet invested, the depreciated value of the property is equal to the capital investment. Omitting for the time being the question of allowing a return on the \$1953 not reinvested, it is seen that allowing a

return on the depreciated value of the property is practically equivalent to allowing a return on the original investment. The question of allowing a return on the amount held as liquid depreciation fund (\$1953) in the above case will be considered under point five. This procedure described above, is therefor fair to the consumer, for he is paying a return on the value of the property in use, and it is fair to the stockholder for he is earning a return on his original capital.

The fourth point is to show that for a company which has stopped growing or for one which is growing at a rate not large enough to use all of the depreciation reserve for reinvestment in extensions, it will be necessary to have a continually varying amount in a liquid depreciation reserve fund and that this amount will fluctuate in a manner depending upon the company's growth.

Table V shows the condition for a property which has ceased to grow after ten years. At the end of the tenth year there are \$1953 in the reserve. The sum laid aside annually for depreciation after that is \$1884, yet owing to the fact that the company has grown faster at one time than at another, in some years there will be less than \$1884 used for renewals and in some years more. The effect of this is to accumulate a fund over a certain period of years which is used over another period of years. Thus, starting with \$1953 in the tenth year, the fund reaches a maximum of \$10,149 in the twenty-fourth year; after which it decreases to \$1953 again in the thirtieth year. This is graphically shown in Curve V. It is evident that since the \$1953 will never be used as far as renewal purposes go, it may as well be returned to the stockholders. Since it is assumed that the company has stopped growing, the hypothesis precludes the possibility of using it for extensions and it should therefor be returned to the stockholders in the form of cash. It should be clearly understood by the stockholders that this is a return of capital and not a dividend payment.

Curve V is for the conditions assumed for this particular case. Any other manner of growth would give a different curve. In order to tell for any other property just what accumulation would take place and to determine how much, if anything, may be returned to the stockholders because it will never be used, it would be necessary to make a study similar to the one shown.

It is not very difficult to see that for a company which is growing, but at a rate too small to use all the reserve, that portion of the reserve which is not invested in extensions and betterments

will bear the same relation to the renewals as the entire fund does in the case where the company is not growing at all. That is, there will be an accumulation curve for the liquid reserve which will be similar to the curve for a non-growing property.

In either case there will be a necessity for a liquid depreciation reserve for renewals and this reserve will vary from year to year. This fluctuation may be likened to the storage of energy in a flywheel. Just as there is no way to remove the energy from the flywheel except by stopping it, so there is no way of avoiding the fund as long as it is desired to make the renewals as they fall due. While the energy is stored in the flywheel it is of no direct use; yet it would be impossible to run the engine without a flywheel. The energy must be so stored to make it instantly available. The depreciation fund must also be stored to make it instantly available.

The fifth point is to show, that since such a liquid depreciation reserve may be necessary for a growing company and will be necessary for a company which has ceased to grow, that the same return should be allowed on such a reserve as on any other capital invested in the property, and that such return should be available for dividends, provided that the cost new, less depreciation is to be used as a basis for rate making.

Before trying to prove this point, the following decisions are given to show the stand taken in some cases in regard to this matter. The Nebraska State Railway Commission says in *Re Application of the Lincoln Telephone and Telegraph Company*, for authority to increase rates (*A. T. & T. Co., Com. L.134 June 26, 1913, Nebraska State Railway Commission*) "It will also be the policy of the Commission to expect of the corporation that it shall, so far as possible, use the depreciation funds . . . in making extensions and betterment of the plant. Such part of the plant as is represented by the investment from the depreciation reserve shall be permitted to earn the same ratio of return as the stockholders' investment, but neither such reserve fund nor the earnings therefrom shall be available as dividends to stockholders, or for any other purposes than those set out."

In this decision the commission allows a return but it seems to consider the reserve as a sinking fund, the returns on which must be put into the fund. Further, it differentiates between investment from reserve and stockholders' investment as though the depreciation reserve were not also stockholders' investment.

In the *Louisville and Nashville R. R. Co. v. Railroad Commis-*

sion of Alabama the special master says (U. S. Circuit Co., Middle Dist. of Alabama. Report of Wm. A. Gunther, Special Master in Chancery, 1911) "The defendants further insist that interest should be allowed on the balance in the replacement account. It is a mistake to suppose that such a charge is proper."

Also in the case of the Louisiana R. R. Commission vs. Cumberland Telephone Co., (212 U. S. 425) the Court says: "That it was right to raise more money to pay for depreciation than was actually dispersed for the particular year there can be no doubt, for a reserve is necessary in any business of this kind, and so it might accumulate, but to raise more than money enough for the purpose and place a balance to the credit of capital upon which to pay dividends cannot be proper treatment."

There are two chief arguments against allowing a return on the depreciation fund. The first applies only to that portion which is not invested in extensions. It is to the effect that since the fund is lying idle, bringing no return, or is at best invested in bonds bringing a low return, that this is all the return to which it is entitled. The second argument applies either to the case where there is a liquid reserve or the reserve is invested in extensions. It is to the effect that since the money for the reserve is furnished by the consumer, he should not further be required to pay a return on it.

Taking the second argument first. The whole discussion hinges to a large extent on the question as to whether or not the stockholder may expect that his capital be kept intact at 100 per cent. How many men would go into a business of any kind if they could not make enough to replace their capital goods as they wore out and besides earn a return on their investment? That all businesses do not do this does not alter the fact that they expect to do so when they start. The recognition of depreciation and the allowance therefor is in itself an acknowledgment of the correctness of keeping the capital intact.

The capital which is wasting away is certainly the capital of the stockholder. He uses up his capital in the service of the consumer and the consumer replaces the capital so used. The consumer is making a just restitution. He is replacing something which originally belonged not to him but to some one else. Why then should the replaced capital have a different status from the original? It should not. The capital in a depreciation reserve fund should be treated the same as any other capital. It should be allowed the same return and for the same purposes.

Some argue that since the depreciation fund is lying idle (*i.e.* that portion not invested in extensions) or at best is invested where it brings only a low return, it is not entitled to more than it can earn. But is it lying idle? It has been shown that for any other than a growing company which can invest the entire reserve in extensions, there will necessarily be a continually varying amount in the liquid reserve. Besides this, even a growing company will have to carry from year to year some of the fund which it cannot reinvest at once. Is the depreciation reserve not just as necessary a part of the business as the working capital, of which there must always be a more or less fluctuating excess earning a low return, but which no one denies is entitled to the same rate of return as the capital actually invested in useful physical property? Is the liquid reserve, which is the stockholders' capital, not a guarantee to the consumer that the property will be maintained in first class operating condition and so give him the best of service? It may be said that he has a right to expect good service, but most people when not considering a public utility are willing to pay extra for good service. Thus, under competitive conditions a company which kept no reserve could give service at a lower rate than one which did, but it would be neither as good nor as reliable as that furnished by a company which kept a reserve. Would the public not be willing to pay for the greater reliability and better service?

No one questions the fairness of the proposition that the company be made to pay interest on deposits of consumers, yet in viewing that question the only consideration is that the consumer is deprived of the use of his money and should receive a recompense for it. The corporation's use of his money is not thought of for a moment in deciding whether or not such a charge is fair. To be sure, the company may devote it to a profitable use, but assuming that the company was not on a paying basis would that in any way alter its obligation to pay interest on the deposit? The stockholder is in much the same position as the consumer described above. He is deprived of the use of some of the money; but why should there be any further consideration of the justness of allowing him a return, regardless of what the corporation does with his money within legitimate limits, than there is in the case of the consumer? If the argument is to be that the funds are lying idle would it not be just as fair on the part of the corporation to say "Because the consumers' deposit will never have to be paid back in a lump sum, we will use them in our deprecia-

tion reserve and since it is lying idle we will have to pay no interest on the deposits''? What a howl would go up!

To bring out the point still more clearly, refer again to Table V. Suppose that an appraisal were made in the twenty-first year when the property was in a 39 per cent condition. It would be unfair to base rates on the \$9783 which is the corresponding value of the property, when it is known that as the renewals are made the per cent condition will go up as high as 68. Under this scheme the rates would depend entirely upon the condition of the property in the year it was appraised and there can be no question as to the unfairness of such a proceeding. The rates should be based on the depreciated value of the property in any year plus the amount in the depreciation reserve, provided only that the sum is not greater than the original capital expenditure.

In conclusion it may be said (1) No matter how large a property is, it will not necessarily come to any fixed per cent condition nor anywhere near it. (2) The per cent condition of any property, the amount in the reserve fund, and the rise of the reserve fund depend upon the past, present, and future growth of the company, and that these conditions and their relations should be studied for any property whether a public utility or a private corporation. (3) Rates should be based upon the depreciated value of the property plus the amount in the depreciation reserve as long as the sum is not greater than one hundred per cent of the total capital investment.

DISCUSSION ON "THE EFFECT OF RECENT DECISIONS ON THE WORK OF INVENTORY AND APPRAISAL" (BETTS), "CONTINUOUS INVENTORIES: THEIR PREPARATION AND VALUE" (CARVER,) "GROWTH AND DEPRECIATION" (LOEBENSTEIN), NEW YORK, NOVEMBER 10, 1916.

W. B. Jackson: I have been very much interested in this matter of detailed inventories and appraisals, and of the need of our electric properties and companies making the accounting of materials and plant coextensive, if I may put it that way, with the accounting of the money elements.

I believe that a detailed inventory and cost record of a public service property is valuable in giving to those in charge of the property a visualization of the property which they cannot obtain in any other way, both from the purely physical point of view and from the point of view of the spread of the cost over the property. Also it gives an exceptionally fine record by which to obtain the proper in and out charge in case of changes and improvements.

I believe that a careful record of ages should be kept of all property, for statistical purposes, but I do not believe that a so-called "depreciated value" or an estimated remaining useful life should be carried along as a part of the inventory and appraisal record, because it is likely to become seriously misleading, inasmuch as the estimated useful lives of the different parts of the property change as the months go by, almost as the days go by, and as they change, so change the estimated depreciated values.

The Wells Power Company, which is now operated by the Milwaukee Electric Railway and Light Company, the operations of which were directed by my firm for many years, carries a fully detailed inventory and cost record of its property. The records are in full detail, and as changes are made they are entered upon change sheets in like detail with the inventory. The change sheets cover the period of a year, at the end of which period the inventory is readily brought to date. These records are considered highly valuable by the managers of the Wells Power Company and the Milwaukee Electric Railway and Light Company.

Mr. Loebenstein's paper is more than anything else a demonstration of the extremely uncertain features of so-called "accrued depreciation," and of the serious danger in making it an important factor in determining the value of a property. In his consideration, he has taken the simplest possible assumptions, which do not agree with practical experience, and draws therefrom direct conclusions. Even with this relatively simple and academic handling of the subject, it is easy to see the uncertainty of the results arrived at. He has divided the property into classes of units, each class being assigned a useful life, and they are treated as though they would actually behave as they are assumed to behave, but they will not do so. Take, for ex-

ample, a plant having four small steam turbine generators, to which, for illustration we may assign twenty-five years' useful life. There is not the least chance that these units actually comply with our assumption. At the end of ten years two might be displaced by a larger or improved unit, and after a while one or two more, and so on.

Let us consider another quite different character of property, such as wood poles. It is possible that fifteen years' useful life may be assigned to them. The useful life of wood poles, *per se*, may vary from six years to twenty years, and the character of ground in which the poles are set may cause a variation of 100 per cent or more in a fairly large system. And so we might analyze each class of property.

Thus, when we superimpose the uncertainties and complications arising from the variables which are found in practise upon Mr. Loebenstein's complex but relatively simple computations, we have a result upon which one certainly cannot predicate values with any reasonable degree of confidence.

Let me state, however, before closing, that where there are no figures developed from actual operation, the best estimate of the amount of annual appropriation, over and above current maintenance and repairs, that is necessary for deferred maintenance and renewals, can be obtained by the use of methods in the general line of those outlined by Mr. Loebenstein, but such year by year estimates, which may and should be revised periodically, are very different from formally predicating the value of the property on figures dependent upon such calculations.

G. W. Whittemore: In the consideration of this subject it may be worth the few moments necessary briefly to recall the several meanings of the term "depreciation", as it is generally used.

In Webster's Dictionary the word depreciation is given two meanings, viz:

1st "The act or process of depreciating", that is, the lessening in value of one kind or another.

2nd "The condition of being depreciated", or of having suffered a loss in value.

An act or process may differ from a state or condition merely as a cause differs from its effect. Yet the two meanings in this case are so lacking in identity, and the methods of expressing or measuring them so far apart, that the distinctions to be made in the unqualified term depreciation must be kept clear.

In the practical problems involved in the management of public and other utility properties, and in the consideration of the former by regulatory bodies, both of these branches of the subject of depreciation have been dealt with under various designations. Among the more common of such designations are:

Anticipated Depreciation, Theoretical Depreciation, or the Expense of Depreciation:

To the act or process of depreciation, as mentioned above,

corresponds the preceding terms which are frequently used to denote this first branch of the subject.

As the term "anticipated depreciation" indicates, it implies the recognition of the fact that as time goes on, all property, as a rule, loses value, or suffers a reduction in the total quantity of service of which it was initially capable. We are accustomed to refer to permanent improvements and fixed capital. Strictly speaking, no improvements are permanent and no capital is fixed. Such property is permanent or fixed only in a relative sense, and in comparison with other forms of property of shorter life. Ultimately, all property used by a company or an individual in his business, except, generally speaking, land itself, is destined to ultimate retirement. "Repairs may postpone but cannot prevent such an outcome."

From this point of view the locomotive used in hauling a train is property consumed in operation, just as much as is the coal burned by the locomotive. The element of time is the only difference in the two cases. The coal may last a few hours. The locomotive may last many years. Eventually, both disappear as elements of cost in the conduct of the business.

Anticipated depreciation, considered quantitatively, is therefore an attempt to forecast the amount or proportion of the reduction in its initial value that will disappear from a property while ownership is retained. In other words, what is to be the total loss suffered during the process of depreciating.

Whether such loss is taken as occurring uniformly or not is a subordinate question. In any event, the final effect is the same; viz., the full amount of the anticipated depreciation is lost or consumed in the conduct of the business.

Such predictions as to the proportionate amount of loss vary, of course, for each class of property. They are estimates, and must all necessarily be based upon the accumulated experience of the past, and upon forecasts of the effects, each in its proper proportion, of the various influences recognized as tending to reduce the useful life of the particular portions of property under consideration.

The point to be borne in mind, as differentiating this anticipated from the other forms of depreciation, is that it is an attempt to look into the future and evaluate what such future may have in store.

Quite frequently, the term *theoretical depreciation* has been used in the sense in which anticipated depreciation has just been employed. The use of this term *theoretical*, however, would seem to offer some chance for misapprehension. Oftentimes the word *theoretical* is employed to contrast what is possible, but not likely, with what is real and certain. There is no doubt, however, about the reality and inevitability of this anticipated or *theoretical depreciation*. The only uncertainty connected with the subject is just how long the limited (and not unlimited), period of usefulness of the particular property in mind will continue.

In place of the term anticipated or theoretical depreciation, when the reference is to the act or process of depreciating, the uniform system of accounts prescribed by the Interstate Commerce Commission for the use of the telephone and telegraph companies, employs the term, the "expense of depreciation." Therein these words are defined as follows:

(a) The losses suffered through lessening in value of the tangible property from wear and tear that are not covered in any prescribed account covering current repairs.

(b) Obsolescence or inadequacy resulting from age, physical change or supercession by reason of any inventions or discoveries, change in public demand or public requirements; and

(c) Losses suffered through destruction of property by extraordinary casualties.

The companies referred to are compelled to include in their operating expenses amounts deemed sufficient to cover the anticipated losses of the character above mentioned, and thereby create proper reserves to recoup themselves when such losses occur.

Otherwise expressed, the particular class of expenses comprehended under the term of "expense of depreciation" are those for major repairs, replacements, or retirements, which experience shows will have to take place in any given property over and above those current minor repairs which must constantly be met.

Sometimes, as a convenient method of indicating the present expectations as to the lasting qualities of any portion of a particular property, this expense of depreciation is associated with, or expressed in terms of anticipated life of such same property. Those, however, who adopt this view should, of course, make careful distinction between what can be regarded as the gross rate at which a property is depreciating, and what may be called its net rate of depreciation. Suppose, as has been done in the examples used in Mr. Loebenstein's paper, that the expense of depreciation is taken at 10 per cent per annum. This means that in the course of 10 years it is expected that 100 per cent of the first cost of the property will have been charged against it under the head of theoretical depreciation or expense of depreciation. Suppose, however, that the property in question, say a particular machine, is from time to time the subject of renewals or replacements of parts of the machine, resulting, let us assume, in drafts upon the reserve for depreciation, amounting, on an average to 5 per cent per annum of the first cost of the property. The actual, or net, average rate of depreciation for the property would therefore be 5 per cent, and the resulting anticipated life of such a property would become 20 years, and not 10 years.

Accrued Depreciation and *Structural Value*: Corresponding with the second branch of the definition above mentioned, viz., the state or condition of being depreciated, are the other terms generally used when reference is made to this branch of the general subject of depreciation; viz., the present depreciated

condition or, as the accounting system mentioned above terms it, the "structural value" of a property. These terms take into account such accrued depreciation as may be determined upon as actually existing in any particular plant. As thus used, accrued depreciation is, therefore, an attempt to measure past effects, as anticipated depreciation is to forecast future ones. The former undertakes to state what shrinkage in value can, as a fact, be found in any property not new. The latter endeavors to predict the amount of loss that will still take place in any property and, to the extent that the same can be approximated, the period of time over which such losses will be spread.

Perhaps the distinction which it is important should be recognized between the act or process of depreciating, whether called anticipated or theoretical, or the expense of depreciation, and the state or condition of being depreciated, as covered by the existing accrued depreciation of any property, whether physical or functional, can best be obtained from the accounting point of view as shown in the prescribed system of accounts already mentioned. Therein it is clearly shown that:

(a) The expense of depreciation, or its equivalent terms, refers to the future; accrued depreciation to the past.

(b) The expense of depreciation is concerned with the operating expense accounts; accrued depreciation with the fixed capital accounts.

(c) The measure of the expense of depreciation is that best estimate, based upon experience, that can be made as to the rate at which it seems likely capital will be consumed in operations in the future; the measure of accrued depreciation the best estimate possible to make of what amount of such capital consumption has, as recognizable facts, already occurred in the plant as it exists at the time of the inquiry.

(d) The time to which such expense of depreciation is to apply is the remaining life of the physical property; accrued depreciation to its expired life. During each such year that the property, or any portion thereof, will continue in use, the effort is to assess the company's earnings, in the form of an expense of depreciation, such uniform amount as will distribute, as nearly as may be, evenly throughout the life of the depreciating property, the burden of repairs (exclusive of current repairs for which provision is made under another account) and the costs of capital consumed in operations.

Both branches of the subject of depreciation into which it has been above divided are involved in appraisals and in rate investigations before commissions and courts.

One of the questions asked by commissions about any property whose fair value they may be trying to determine is this—"What is the reproduction cost, new, of such property?" Such question being assumed to have been satisfactorily answered, the commission can then be regarded as saying something like this. "We have now been told what the property would cost if cre-

ated at this general time, and if it were all new. As a matter of fact, we know it is not all new. Let us remove this limitation as to newness. Now advise us as to how much less valuable this property may be, from the standpoint of how much less quantity-of-service of a proper quality it may contain, than would be a property entirely new.

The difference between the two amounts, as understood, would be the accrued depreciation that could be said to reside in such property, and which question was raised in the Idaho case referred to by Dr. Betts in his paper.

Besides wishing to ascertain the accrued depreciation in any particular property, the courts and commissions are also interested in those portions of the company's expenses which it may be charging against earnings under the heading of the expenses of depreciation, or the utility's estimate of the average rate at which the process of depreciating is in progress in the different parts of the utility's property.

To give this information to the regulatory bodies, special accounts have been set up under the prescribed accounting system. These show the results of any schedule of estimated rates of depreciation expenses adopted by the utility. They indicate, likewise, the drafts or charges being made from time to time against the reserve for depreciation resulting from such expense of depreciation charges.

Examinations of these accounts made by the regulatory body, or of the annual or other reports in which they are embodied, will indicate the rate at which such reserves may be accumulating, or, on the other hand, failing to accumulate. They also show the extent to which the appropriations for depreciation expense may have actually been meeting the particular burdens of major repairs, replacements or retirements of property which they are designed to cover, as indicated by the charges which may have been made against the depreciation reserve.

In Mr. Loebenstein's tables and curves both phases of depreciation as above indicated are taken into account, the expense of depreciation being equivalent to what Mr. Loebenstein refers to as "increments to the depreciation fund," while the present depreciated value or structural value corresponds to the per cent condition referred to in the same tables.

In determining what may be a proper expense for depreciation and, consequently, what may be the net rate at which a property is estimated as progressing toward a depreciated condition, a number of important factors must be taken into account. One of these factors is the element of growth. In some of the simpler cases, those in which this factor is the only one at work, the curves and tables shown by Mr. Loebenstein are intended to indicate what the results of a uniform expense of depreciation applied to a growing property would be upon the reserve for depreciation and the computed present condition of such property. For cases such as this the element of growth is shown to have a marked effect.

Generally speaking, it is believed that the influence of growth on the problems of depreciation is often not taken into sufficient account. Any property, particularly one of the composite character usually met with in actual cases, and one which is the subject of considerable and frequent additions of new elements, obviously will maintain a condition nearer newness than would a property not receiving such additions; so that, with respect to the depreciated condition of a property, either as to a particular time or as an average condition for any period, growth must be taken into account.

But, furthermore, if any attempt to test the reserve for depreciation as a ratio of the total plant in existence at the present time be adopted, the element of growth must here also be given its due weight. The amount in any reserve of depreciation is the result of the schedule of rates for the expense of depreciation which may have previously been in effect, and which rates have been applied to property previously in existence. Any drafts or charges which have been made against such reserves have, as a general proposition, been on account of property old enough to have reached a condition where major repairs, replacements, renewals, etc. have become necessary. Properly, therefore, the amount in such reserves should be related, as a ratio, only to that property which was in existence when such reserve was being accumulated. To refer such a reserve, so accumulated, to an entire property which might, perhaps, include recent additions, would result in a lower percentage of reserve to any plant than would have been the case if the ratio had been obtained before the additions referred to had been made. In other words, unless the element of growth be taken into a proper account, any comparison of reserve for accrued depreciation to the total present property, or any comparison of the effects of any particular schedule of depreciation expense rates to charges being made to the reserve for realized depreciation to cover concurrent major repairs, replacements, retirements, etc. may lead one into serious error.

Other elements beside growth have their effect upon depreciation in one of its phases or the other, and, as such, should be given their proper weight. Among such other influences might be mentioned any tendency which may be present to substitute the longer lived elements of a plant for the shorter lived ones now in place; another one might be improvements in design or engineering which would permit of necessary growth or enlargements without as extensive removals of previously existing plant as had before been necessary. Other influences might also be mentioned which would have their effect, either upon the expense of depreciation, or upon the accrued depreciation at any time in a property.

The value and purpose of computations such as Mr. Loebenstein has made are to be found, of course, in their demonstration of the effects that such elements can have in supposed cases.

In all instances, however, in which they enter they have some effect. And such elements have their effect even in those instances, not mathematically to be analyzed, where the actual property may, as in cases in mind, consist of 30 or more subdivisions, each of which relates to a different kind of property, each, subject to its own rate of growth or replacement, large or small, which growth or replacement may be quite irregular one year as against another; and which property subdivisions may be considered to have expectations of life ranging all the way from land, which is supposed to have no life limit, or vitrified clay conduit, whose life is indefinite, to other portions of the property which may require renewals every five or six years.

With respect to the relation of accrued depreciation to the base upon which to allow a fair distributable rate of return: as understood, Mr. Loebenstein regards as unfair for such purpose any base obtained through the deduction of any reserve for depreciation from the depreciated value of the property. Probably few, if any, will dissent from this view.

If the reserve for depreciation be deducted from anything, it would be nearer correct to subtract it from the undepreciated, instead of from the depreciated value of any property, whenever the problem under determination be the proper base upon which to allow a fair distributable rate of return.

And even in this case, such deduction of the reserve from the full 100 per cent value of the property, new, would not be based upon any consideration of depreciation, as such. Rather would it be founded upon the recognition of a divided equitable ownership in any property owing its existence, in part, to any depreciation reserve derived from the rate payers, and which reserve had been set up, specifically as such, in the company's accounts.

For the reserve for accrued depreciation, under the prescribed accounting system above referred to, can be regarded as amounts still standing to the credit of the rate payers, and representing specific provision by them for losses estimated as currently accruing in the property while they had been enjoying service from it. In time, such credited amounts will assist in covering future major repairs, replacements, or ultimate requirements of such property. Meantime, it is being held by the company, in some asset form or another, and offset by a special liability account showing the amount of such special assets, as a part of the total assets in the company's possession, until such major repairs, replacements, or retirements become necessary or economically justifiable.

Until the amounts in such reserve are actually absorbed for the purposes for which they had been collected from the consumers, it would seem correct to regard the equitable, although not the legal, title to the portion of the assets, in dollars, representing such amounts, as residing in the rate payers.

As thus viewed, therefore, if from the total assets held by the company, taken at 100 per cent of their full value, there be de-

ducted that portion of the assets, also taken at 100 per cent of their value, new, owing their existence to the reserve for accrued depreciation as it may then stand in the accounts, the remaining assets would represent those held by the company, free from any such equitable claim of the creators of the accrued depreciation reserve.

Whether any further deductions should be made from a base derived as in the preceding, in the case of the utility which, in the past, had enjoyed earnings sufficiently ample to make full provision for any reserve for depreciation up to the amount of the real existing accrued depreciation in its property, but which had failed so to do; or whether, on the other hand, as items perhaps in its "going value", any addition to such base should be made in the case of the company which had made provisions to its reserve for depreciation, but had been compelled to do so in the face of inadequate distributions in the past to its owners, would seem to be separate questions—along with others which could be raised in this connection—for separate determination.

David B. Rushmore: There is one point concerned with depreciation which I have never heard mentioned in any discussion, and which I believe has not been taken in consideration by commissions or engineers in determining the proper figure for depreciation. Depreciation is an attempt—and it may be a very unwise attempt—to guess what the future has in store. An attempt is being made to keep the value of the capital invested intact by trying to guess just what the future will be.

When we are thinking of value, what are we thinking of? We say that the capital must remain the same, but value, as it really exists, exists only as regards the necessities of life, and the point which I have never seen considered, and on which I would like very much to hear an expression of opinion is why should not the factor of gold depreciation be considered in connection with the subject of the depreciation of property?

In the period of fifteen years from 1900 to 1915 gold depreciated on the average $3\frac{1}{3}$ per cent a year, and the man who had his money in the savings bank, that was paying that much interest, was just keeping even in his position, while in the case of a man who owned bonds which paid interest of $3\frac{1}{3}$ per cent, as some of them do, approximately, he was not getting ahead at all. Now, we are for the present moment existing under very abnormal conditions of economics, of finance, of trade, and apparently we are going to return to the same condition of gold depreciation. Therefore, why should not the permanent value of the property be measured in the value of the commodities which make up the necessities of life, and not in something which represents a medium of exchange or something which represents an artificial value, and which is not in itself fixed.

Edward J. Cheney: As Dr. Betts has very well said, it is necessary for us to abide by the decisions of the courts. It is also entirely proper that we should respect those decisions. I

think, however, that the courts themselves are quite willing to be educated along the lines of these questions, which, because of their newness and complexity, are very perplexing to the judges. We should not be bound too rigidly by decisions with which we do not agree, but we should by just such meetings as this, endeavor to clarify the situation and enunciate proper principles. No one, I think, is so well qualified to put the matter in proper shape as engineers, who deal with the physical property and with actual operating conditions.

It is true that a great deal of stress has been laid on reproduction costs in valuation and rate cases of one sort and another, but that has doubtless often come about because in such cases accurate records of the investment cost were not available. I believe that when, as will in the near future be the case, records are available which show exactly what was spent for the property; and assuming that the investment was honest, prudent and timely; the money actually put in by the investors will be the proper basis for estimating a return in rate cases; and if so, it certainly will be the proper basis in purchase and sale cases.

It is a little bit off the subject, but I want to take this opportunity to register my emphatic protest against the use of two terms which are very commonly employed in connection with this subject. One is "going concern value". It is entirely misleading. I do not question at all the justice of including something for those items which are ordinarily included in the term, but the term itself is wrong. A public utility has no right to earn a return on an indefinite "going concern value" any more than it has a right to earn a return on what some have maintained was the franchise value. On the cost of establishing the business, on inadequate returns in the early stages, and on similar items, it has a right to expect a return, but let us call them what they are. The expression "cost of establishing the business" is more nearly correct, in my opinion, than anything else, and seems much preferable to "going concern value".

The other term which I object to is "contractors' profit". How many estimates we see with a percentage tacked on for "contractors' profit"! I maintain there is no such thing. The percentage a contractor gets, over and above labor and material cost, is to pay his overhead expenses and to pay him for his own services. He makes no profit. He may, it is true, make money on one job, but on another he will lose, and in the long run he gets only enough to keep him in business, and the percentage is not a profit but an item of expense. "Overhead expenses of construction" more nearly describes that item.

Relative to depreciation, public utility companies invariably expect that, in fixing rates, there be included in operating expenses the amount of estimated current and accruing depreciation. At the same time, they often, doubtlessly honestly, ask for a return on the full original cost of the property. If you lend me \$1,000, you have a right to the interest on that money,

but as soon as I pay back part of the principal the amount of interest is correspondingly reduced. Accrued depreciation, charged to operating expenses and paid in by the customers of the public utility company, is to that extent a return of the original capital.

William S. Franklin: I would like to point out, in connection with the question raised by Mr. Rushmore, that the influence of depreciated money or gold on the values of properties is taken account of in what is called "cost of reconstruction." The fact that gold does depreciate is an added reason for placing greater emphasis on cost of reproduction in estimating present values of a property.

The difficulty, however, is that the cost of reproduction includes another variable as well as the variation in the value of gold, namely, the variable which comes from improved methods and improved machinery, which may tend to lessen the value of the property as based on cost of reproduction, whereas the depreciation of gold alone would tend, if there were no advance in methods and machinery, to increase the money value of the property: If we could only devise some means for separating these two variables as they enter into the cost of reproduction, we could then take account of the two separate influences.

Philander Betts: In reference to the paper submitted by Mr. Carver, I want to emphasize two or three things that I have had in mind with regard to the value of keeping inventories and appraisals of a property, and of keeping them continuously up to date. The thought that has occurred to most people when you mention an inventory and appraisal is that the sole purpose has been to find out as of some given date the total amount of property in existence and its value at that time. That is only one of the reasons for making an inventory and appraisal of a property. The telephone companies for years have kept a continuous inventory, perhaps not in the same form that is usually employed in making up an appraisal, but it has been kept for operating reasons, so that the telephone company could know at any moment just where it had property, and how much it had, so that it could tell a prospective customer whether it could or could not furnish service of a certain character to a certain extent, and if it could not immediately furnish it, how soon it could furnish it.

Another reason for keeping an inventory, and along with that inventory the cost of the various portions of the plant as they are constructed, is in order to make the construction of the extensions more efficient. An analysis of construction costs is essential in the carrying on of any contractor's business. Why should not such an analysis be made of the construction costs of a public utility company? The keeping of such inventories, and accompanied with the inventory of the property the cost of the sections of the property, would lead to an analysis of the unit cost for those sections, which would show whether or not the

extensions were constructed in the most efficient manner possible under all of the circumstances. Such an analysis might lead to better methods of doing the work. It might lead to doing the work at different times during the year, or, instead of doing it in certain piecemeal methods, without knowing just how much would be done, it might lead to doing it in a more systematic way.

In this connection I will call attention to what the telephone companies in the East do. Estimates are made up as to the probable growth in different directions—the probable number of new customers taken on—and estimates are also made as to where these customers will probably be located, and as to what property will probably be necessary. Orders are then entered for certain amounts of material a considerable time in advance. The total number of poles which are estimated to be used will probably be used without much change in the size and height of those poles. It may be that some changes will have to be made in the orders given for certain sizes and lengths of cables, but with a proper study based upon the running inventory, and the accompanying cost sheets, a company can certainly construct the additions to its plant in a more economical manner than is very often the case.

I want to answer some questions with regard to some of the points in my paper. I have referred to the fact that in several cases the courts have laid down the rule that what the company is entitled to earn a return upon, was the value of that which they devoted to the public use, and that this might entail deductions for property not at present in the use of the public. When I spoke of that I did not mean deductions for that portion of the property which was properly held in reserve. Every company that pretends to give continuous service must have property in addition to that demanded by the peak load in order to insure continuity of service. If companies are to take on customers from day to day, there must be some property created at least some little time in advance of its immediate use, so that there must be some reserve in the plant to accommodate these customers who come along every day. There must be some reserve in plant to safeguard against interruptions in service due to breakdowns of portions of the plant. They are every day occurrences, and must be guarded against, and the provision of a certain amount of spare plant is the usual and ordinary precaution.

I have in mind a definite case. In the southern part of New Jersey, there is a very large gas company situated about forty miles from Camden. Some years ago a project was evolved for the construction of a tunnel under the Delaware River from Philadelphia to Camden. The project was an ambitious one, some property was purchased and attempts made to float the scheme. Without going into the history of the case, suffice it to say that the scheme has never been carried through, but while

the scheme was being thought of, a group of enterprising people went down into the lower part of New Jersey and formed eleven small gas companies in the towns and villages served by the railroads which would probably connect with the proposed tunnel. These eleven gas companies were later consolidated into one gas company, with a large central plant, which was built at a central point, and gas has been delivered for a number of years from that central point. In the design of that plant, care was taken to see that there was capacity for several times as many people as are found in the territory at the present time, with a view to all those who might have been found in that territory today, if that tunnel project had gone through.

Now, I submit this question, and I will leave it to you to answer it—would it be fair today to say that the people now served with gas in that territory should be charged rates that would give an adequate return on the value of the plant which was constructed and designed for several times as many people as are now making use of it? In all probability, if the promoters of the scheme had thought that the tunnel was not going through this gas company would never have been formed.

The point of it all is this: That a company, before it obtains a proper number of customers, is in such a developmental stage that it is impracticable to collect charges based upon a schedule of rates that would return a profit when the company is very small. The large gas company, to which I have referred, is in just that position. It must build its business up to a point where it will fit the plant which it has, before it can say to the customer that the rates must furnish a return on all its investment.

There is one thing which should be referred to in this discussion, and that is as to the power of the courts. The power of the courts seems to be misunderstood by some, in this way: courts have never had and do not now have the power to fix rates. The courts have the power to prevent confiscation, and to prevent, from the other standpoint, the collection of unreasonable rates. Probably all of the cases which have gone to the Supreme Court of the United States have gone there because the company contended that its property was being confiscated, and when the courts have held, as they have in some of the cases, that such returns as 3.5 and 4 per cent were not a sufficient basis for throwing the case out of court and declaring the rates improper, these decisions were based, not on the idea that such rates of return were adequate, in any sense, but that they were not confiscatory. That is all these decisions have ever said. The court can also determine whether the customers themselves are being asked to pay excessive rates.

In one of the cases before the New Jersey Commission, both the company, from its viewpoint, and the customers affected, from their viewpoint, appealed the case to the upper court. Why? Because the company, feeling that the rate was too low, contended that it amounted to a confiscation of its property.

The customers affected, on the other hand, appealed to the court, saying that the rates fixed by the commission were too high, and and involved collecting from them exorbitant charges. In that case the court did not pass on the facts, it determined that the facts had been passed on by the Commission, and the lower court decided it was neither confiscation, considered from the one direction, and did not say it was charging an exorbitant rate, considered from the other direction.

Harry E. Carver: In reference to the point Mr. Jackson brought up about the accrued depreciation on each item, you will notice that Forms 1 and 3, which constitute the Continuous Inventory Records, did not provide for the computation of the accrued depreciation on each item. They do, however provide space for recording data from which the accrued depreciation may be computed at any time it is desired. Hence, if it should seem advisable at any time to compute depreciation upon a different basis than that upon which it was previously estimated, the continuous inventory record would not be changed or altered in any way.

In connection with this subject some of you may have read the paper on "Continuous Inventories", which was presented at the last meeting of the American Electric Railway Association, held in Atlantic City, in which forms were worked out for each item year by year. I believe that these forms were made up in this manner because the taxing officials in New York State, and perhaps in some other states, require reports each year, in which information must be given as to both cost and the present value of property in considerable detail. If the depreciation is to be computed each year it seems that practically double work would be required in keeping the inventory records, because for every item of property there will have to be an entry made every year on the continuous record; whereas, if a summary only is made every year, the calculation as to the depreciation could probably be made covering a group of items and thus the amount of work would be greatly diminished. For that reason, and because of the great amount of estimating necessary in figuring depreciation, it seems to me it would hardly be advisable to attempt to make any depreciated values a part of the continuous inventories record.

W. R. McCann (by letter): It is to be inferred from a careful reading of Mr. Betts' paper, that the author submits the holdings of the courts to sanction *only* a reproduction method of valuing public-utility property, to the utter exclusion of all other methods. It is the belief of the writer that the correctness of such a deduction is to be challenged. In support of a contrary view, it may be well to examine one or two typical court decisions which apparently *may* be construed in accordance with the author's interpretation.

In the aforesaid paper, a pioneer case (*Smyth vs. Ames*) is cited to show that, in addition to the reproduction method, fair

and reasonable rates should be fixed only after there have been ascertained the original cost of construction, the amount expended in permanent improvements, the amount and market value of its bonds and stock, the present as compared with the original cost of construction, the probable earning capacity of the property under particular rates, the sum required to meet operating expenses, and other matters. Certainly the case of *Smyth vs. Ames* does not support the exclusion of other evidence of value, in favor of a reproduction method as the sole and only correct theory.

The basis of the claims that the courts favor a reproduction theory is found in the language of certain judicial opinions—in language which is constructed to mean differently from what is actually stated. For instance, in *Des Moines Water Company, vs. City of Des Moines*, the court says:

“The question is not what it (the plant) cost, although such evidence is admissible as having a bearing. The question is not what the plant some day may be worth, although evidence with reference thereto may be considered as having a bearing. The question is: What is the value of the plant today?”

(192 Fed. 193, 196)

From such language it is argued that the value of the plant must be the reproduction value and that the words—“the question is not what it (the plant) cost”, mean that an original-cost valuation is to be given no weight. There is a vast difference, however, between the price which has been paid *in toto* for a plant (“what the plant cost”, to use the court’s language) and a properly prepared original-cost valuation. A correct original-cost valuation has its basis in the same inventory as does the reproduction valuation; but, instead of present-day prices (or five-year average prices) being used in the appraisal, the actual cost prices are used for both labor and material, or, in the absence of records of the actual original costs of items of material and labor, the cost is estimated by a competent appraiser as of the time when the equipment was installed and under the precise conditions of its installation.

Likewise, in *Cumberland Telephone and Telegraph Company vs. City of Louisville*, the court said:

“It would seem clear from the decisions that the most material question in such cases is that the *reasonable value* of the property ‘at the time it is being used for the public’, that is to say, the *time at which the question arises*—it being upon the reasonable valuation at that time that the company is entitled to earn a fair return * * * * The value of a plant may depend upon good fortune, upon good management, or upon fortuitous circumstances, but in every event the reasonable value of the property ‘*at the time it is used for the public*’ is the value we are to ascertain for the purposes of this controversy.”

(187 Fed. 637, 642)

From the language “value of the property at the time it is used for the public” and from the similar language of other court

decisions, it is again argued that the reproduction method must be used exclusively. It seems to have escaped the notice of the reproduction advocates that the language of the courts may well be interpreted to mean "the reasonable *depreciated* value of the *used and useful* property at the time it is used for the public".

Many courts have sanctioned and justified the reproduction theory because it is generally assumed that precise original cost ordinarily is difficult to secure. Usually the record before a court of review has little tangible evidence relating to a properly prepared original-cost valuation. The record may confuse the investment, the stocks and bonds, or a purchase price with the original cost of the various items embraced in the inventory. Before construing the language of a court which is reviewing a record taken in a trial court, it is well to ascertain first what that record contains on the subject of original cost.

Of a proper original-cost valuation, Ex-chairman Halford Erickson of the Railroad Commission of Wisconsin stated in a paper presented before the Conference on Valuation, held under the auspices of the Utilities Bureau, in Philadelphia, a year ago:

"When the original cost of the existing property is desired it can be computed upon the same inventory as that used in determining the cost of reproduction and upon prices which cover the period when the property involved was put into the plant. Such price lists may be had partly from the records of the plant and partly from other sources. In this way the original cost of the existing property can be had with even greater accuracy than the cost of reproduction."

(*The Utilities Magazine*, Vol. 1, No. 3, 113)

It is interesting to note that Chairman Erickson, after years of experience and participation in rate-making procedures, volunteers the opinion that even in the absence of books and records, "original cost of existing property can be had with even greater accuracy than the cost of reproduction."

Despite the many citations from court decisions favorable to some reproduction method of valuing utility property, it is noteworthy that no authority of standing is to be quoted to show that an estimate of the cost of reproducing the property (with or without deduction for accrued depreciation) is the sole and only guide to a reasonable and adequate valuation of a utility property for rate-making purposes. On the contrary, the inconsistencies of the reproduction method have been discussed time and again; it is only recently that the Supreme Court of the United States, in the *Des Moines Gas Case*, repudiated the reproduction method when applied to what, in valuation work, is commonly termed "undisturbed paving". The general un-stableness of the reproduction-new theory was realized and understood by prominent proponents of the Federal Valuation Act. Senators Bristow of Kansas and LaFollette of Wisconsin, on February 24, 1913, participated in the following colloquy on the floor of the United States Senate:

Mr. Bristow:

"There is one point I wanted to bring out with regard to that feature of the bill that requires the Commission to ascertain the cost of production new. Such a finding, in my opinion, is not of any great value, so far as the rate making is concerned. It is a vacillating quantity; it does not represent in any sense the investment of the company in the construction of the road. To illustrate: In the suit that was pending, the estimated cost of the reproduction of the Northern Pacific Railroad was involved. I am informed the same engineer reported in 1907 and in 1909 as to the cost of the reproduction new, and the value fixed in 1909 was one hundred and eighty-five million dollars more than the same engineer fixed the value of reproduction new in 1907."

Mr. LaFollette (in part):

"Let me say to the Senator on this question that the Supreme Court of the United States has listed that as one of the values to be considered, and it has not yet by any express declaration eliminated it as a value to be ignored. So it seemed to the committee that we ought to give it, its place here. I will, however, say to the Senator that I am confident that the views of all the advanced commissions of the country that are doing this valuation work are that there should be very inconsiderable weight given to reproduction new."

(*Congressional Record*, 3801.)

The reproduction method of valuing property is relied upon by utilities mainly because it automatically takes care of the appreciation which has occurred during recent years in the cost-new of nearly all items of equipment and in all classes of labor. Land, in particular, falls into this classification, and a court of authority has ruled that the real property of a utility should be valued at its present-day market value, and not at its original cost plus the cost of improvements. Under the rulings of the courts, it may be argued that, even though a utility may steal equipment without being apprehended and may convert that equipment into used and useful property in the service of the public, the stolen equipment must receive due recognition in a valuation and rate-making proceeding. Whether or not this view will prevail ultimately, under a continuance of state regulation, is somewhat a debatable question at the present time. A simple case will serve to illustrate the fallacy of too great weight given indiscriminately to appreciation in utility property. Assume that an electric plant, in a state where the laws provide for state regulation, costs \$100,000, and assume further that the regulatory body of jurisdiction, after investigation, has fixed rates such as will yield full operating expenses plus five per cent per annum (\$5,000) for accruing depreciation and seven per cent per annum (\$7,000) for a *fair* rate-of-return. At the end of five years, provided no change is made in the electric property, the utility has accumulated \$25,000 (plus earnings) in a depreciation fund, and each year has paid a full and adequate rate-of-return upon this investment. During these five years, if perchance the prices of labor and materials advance so that the

estimated reproduction-cost-new according to expert appraisers would be \$110,000, there has been an unearned increment, over and above a fair rate-of-r turn, amounting to \$10,000 in the value of the property—equivalent to \$2,000 per year, or two per cent annually on the original cost. In other words, a valuation made at the end of the said five years, resulting in revised rates being fixed on an estimated reproduction theory, capitalizes an unearned increment which automatically results in rendering a nine per cent rate-of-return throughout the entire first five-year period. What has the utility done or denied to itself in order to deserve this unearned increment? Is not the public entitled to participate in the appreciation of property, at least to the extent of not having the same capitalized against it, to be borne by the rate-payers of the future? Carrying the illustration still further then, let it be assumed that the estimated reproduction value sinks to \$90,000 at the end of five years; then the reverse is true, and the utility each year is deprived of just earnings equivalent to two per cent of the cost of the property. Under such conditions, would it not be argued that this deprivation of earnings would constitute a confiscation of property?

Such illustrations are indicative of the public's vital interest in what is termed "appreciation". It is to be borne in mind that "depreciation", as applied in valuation work, in no manner is the opposite of appreciation". An original-cost valuation, if properly compiled, does not presume to inflict upon a utility the losses occasioned by decreases in prices of material and labor. An original-cost valuation, however, does presume to reflect the conditions under which the bargain between a utility and its consumers was consummated. Under an original-cost valuation, the public sustains all losses due to the falling off of prices, although it participates in gains only to the extent of not having an unearned increment capitalized against it. As stated before, the courts have not stated that reproduction-cost-new (or less depreciation) must be the criterion by which to judge the present value of utility property for rate-making purposes.

The Massachusetts Public Service Commission, in its recent decision rendered *In Re Bay State Street Railway Company* (August 31, 1916), squarely recognizes that appreciation in land as disclosed by a reproduction method of valuing the same is not to receive recognition in a determination of rates:

"Considering this appreciation upon its own merits, car riders cannot fairly be expected to pay higher fares because land has increased in value, nor ought they to pay lower fares if it should decrease. If the company wishes to sell such property it is, of course, entitled to whatever profit it is able to make; but so long as land is employed in the street railway business it is dedicated to a public use and held subject to the conditions fairly attaching to such use. As the Commission has said in another connection (see House Document No. 1900 of the current year, pp. 88,89): 'While no fair-minded man will deny that those who put their money into public service by building railroads are entitled to the oppor-

tunity to earn a fair reward, that this reward is to be determined, so long as their property is devoted to public use, not by investment or by service rendered, but in large measure by the rapid expansion of real estate prices in the larger centers of population, is contrary to sound public policy. It would mean that communities would be penalized by their own growth, and would lose all advantage from the fact that their transportation facilities were created in due season under favorable economic conditions.' It should be added that, even if the doctrine of present worth were accepted, the figure to be used in rate making would clearly be present worth for street railway purposes. In this case no evidence whatever has been submitted that the land has increased in value for such purposes."

(10 *Rate Research*, pp. 120 121,)

It would seem, therefore, that engineers as a whole may well listen to the admonitions of the courts, instead of becoming partisan advocates of some theory. Such biased acts on the part of the profession are accountable for rebukes of a type such as was administered forcibly by the late Judge Smith McPherson of Iowa, who, it is claimed by some, made a grievous error in the Missouri Rate Case (168 *Fed.* 317) by apparently giving too great weight to the testimony relating to certain new theories advanced by experts. In one of his last opinions, this caustic Iowa judge called attention to the great danger of experts. Judge McPherson's life was largely behind him, and he had had more than his fair share of experience as a United States district judge in endeavoring to weigh the evidence of experts in various public-service cases, when he said in the Des Moines Gas Case (199 *Fed.* 205):

"Too often we have selfish, partisan, prejudiced, and unreliable experts engaged for weeks at a time at \$100 or more and expenses per day, exaggerating their importance and making the successful party in fact a loser."

Frank Gill: If Mr. Loebenstein contends that the plant of a normally conducted undertaking does not eventually settle down to a definite per cent condition, I do not agree with him, but if he only means that there is not a similar fixed percentage condition for all undertakings, I think he is quite right.

Fig. 1 shows the amount necessary in the depreciation fund for three theoretical cases, each with the same equated life but with a different rate of continuous growth. This clearly shows that each rate of growth results eventually in a definite per cent condition.

In each case there are 10 classes of plants having lives varying from 6 to 29 years and if a greater number of classes had been used, curves would have reached a steady condition at an earlier period.

Other calculations show that the per cent condition depends on the equated life of the plant as well as upon the rate of growth.

In these cases the Sinking Fund Method (at 5 per cent per annum) has been used for reasons which I consider conclusive, but this is really an independent question.

I do not think that Mr. Loebenstein has made sufficient allowance for the fact that while a definite life can be assigned to one class of plant, the individual components of that class do not in practise need renewals at exactly the same time.

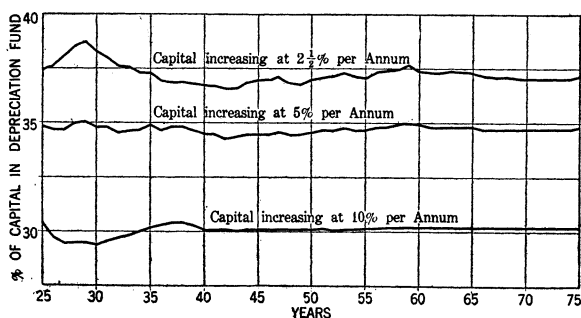


FIG. 1

I notice that in Mr. Loebenstein's calculations, he has allowed a full year's allowance for depreciation for the first year and if this is correct, it follows that the expenditure for the year took place on January 1st, and that the renewals would occur a full year sooner than shown.

L. R. Nash (by letter): It is surprising that a matter of so much importance as the effect of growth upon the average condition of physical property should have received so little attention in engineering literature. The paper on this subject by Mr. Loebenstein is very timely, particularly in view of the increasing attention to valuation studies in connection with rate regulation. The author's choice of public utilities to illustrate the points which he develops is to be commended because of the consistent growth and the predominance of valuation activity in this field.

It seems to me, however, that the illustrations which the author presents in tabular and curve form are not generally representative of average utility conditions. Most of these illustrations assume growth for a very limited period of years, after which the property remains stable. With this assumption, quite wide variations are found in renewal requirements and per cent condition. While the author points out that each of the cases assumed may be considered as one group of elements of a composite property, he still concludes that such a property would show a considerable variation from time to time in per cent condition.

Public utility history shows very few cases of property without sustained substantial growth. A few interurban railways and hydroelectric developments might be excepted, but the growth of the normal city requires continued expansion of its utilities. Even the case of the actual electric property, covering a period of one hundred years, which the author presents as an illustration, as-

sumes that growth ceases after three years, the remaining ninety-seven years showing no expansion whatever. It is not surprising that under such an assumption the service value of the property shows a fluctuation between 37.5 per cent and 69 per cent as found by the author. It is believed that actual conditions are more nearly represented with respect to fluctuations in service value by Curve VII which the author reproduces from Mr. Allison's report on the United Railways Company of St. Louis. This curve, however, allows for no effect of property growth.

The writer had occasion about two years ago to make a study of public utility depreciation and replacement requirements, particularly their relation to total property value or investment. The general results of this study were finally embodied in a paper prepared for the American Economic Association and appearing in the *American Economic Review* of March, 1916. This paper shows by a variety of curves the effect of property growth, and gives formulas and tables for computing replacement requirements under certain assumed normal conditions. In connection with this study the writer had a table prepared showing the history of an assumed typical public utility for a period of one hundred years. The assumptions include growth at the rate of 10 per cent per year for the first twenty years, $7\frac{1}{2}$ per cent per year for the next thirty years and 5 per cent for the remaining fifty years. The property was assumed to consist at all times of elements having useful lives uniformly distributed between ten and thirty years and an equal value of elements in each life group. A copy of that part of the table showing for each year the total investment, cost of replacement of discarded property and the relation between the two is presented as Table I. While this table does not directly show per cent condition, it is believed that uniformity in annual replacement requirements implies corresponding uniformity in per cent condition if, as assumed, all replacement requirements are given prompt and systematic attention. A study of the attached table shows a surprisingly close agreement among the ratios of replacement cost to total investment. There is, in fact, during the last twenty years of the period a variation of only about two per cent in the yearly percentages from their average. In earlier years there is, of course, less consistency because of changes in rate of growth and immaturity of the elements of the property. It is the writer's belief that the attached table represents fairly closely the normal condition of an urban utility, although the assumed uniformity in value of elements and regularity of life will not obtain in practise. This does not sustain the author's conclusions that no approximation to uniformity in per cent condition is to be expected even if growth continues. As the rate of growth increases, per cent condition will normally increase with full maintenance but, as the author states, a large liquid depreciation reserve is not necessary.

The author further comes to the conclusion that depreciated

values should be used in determining equitable rates, basing this contention upon calculations which show that depreciated value and depreciation reserve are together equal to capital investment. If adequate depreciation reserves were always available, there would be no question of injustice to investors in using depreciated value, if a full return were available from an investment of the reserve. There are, however, state laws which prohibit distribution of income from invested depreciation reserves to stockholders. Under such circumstances the use of a depreciated value would deprive the investor of an adequate return.

The writer wishes to voice his opposition to the use of depreciated values in rate cases, recommending instead, full value or investment in connection with a sinking fund rate of accrual for replacement purposes. It is easy to show that under normal conditions the combination of a return on full value plus the comparatively small sinking fund accrual for replacements is approximately equal to a return on depreciated value together with the larger straight line accrual for replacements.

The depreciated value method involves several serious difficulties. The average utility does not earn an adequate replacement reserve in its early years, and with a reasonable hope of making up the deficiency in later more prosperous years when funds are actually needed, dividends are given early preference. The utility may fully expect to adequately provide for all the necessary upkeep of its property, but would be seriously embarrassed by an early rate proceeding which established a depreciated value before the supplementary replacement reserve was accumulated. Furthermore, in a rate case where the utility had carefully accumulated what in its judgment was a full depreciation reserve, it would probably be found that engineers of the supervising commission would find in their judgment, on examination of the property, a higher or lower depreciated value than that estimated by the utility. To the extent of the difference between the two estimates the patrons of the utility or the utility itself would be done an injustice in a rate proceeding. Such probable injustice is entirely avoided by using an undepreciated value with a sinking fund rate of accrual, which requires compounding of the annual contributions to the reserve to make up full ultimate replacement requirements. Utility and commission may disagree upon the useful life of physical property but such disagreement does not affect the investor's return, involving only the amount which patrons should contribute for the upkeep of the property. There is usually ample opportunity of adjusting and readjusting the annual accruals for replacements to meet actual requirements. If a commission finds that a utility has neglected to accumulate a suitable reserve, and at the same time has paid excessive dividends, the proper remedy, it is submitted, is to order a reduction in rate of dividends until the earlier excess has been offset rather than to permanently reduce the fair value of the property.

With the sinking fund method it is necessary to provide safe investment for the annual accruals with adequate return thereon. There is usually sufficient growth in public service properties so that they may invest their reserves in their own business, such investments being accounted for separately from property for which outside investors have furnished the funds. The requirements for a liquid reserve are not different from those under the straight line method. In the long run with approximately uniform replacements, about 60 per cent of the annual cost is provided from current contributions, the balance from income of the invested reserve which will normally accumulate during the early years of the business to approximately 40 per cent of the total investment.

The author assumes that if a utility stops growing and cannot use straight line replacement accruals for the temporary financing of extensions, such accruals might be returned to stockholders in cash, as a part return of capital and not as a dividend. It is believed that such a procedure is distinctly undesirable in the case of public utilities. Conditions might arise in which, without material growth the original property was allowed to seriously depreciate and a large proportion of its original cost be returned to the investors in addition to dividends. In case of unwise regulative restrictions, the investors might decide under such circumstances, that it would be expedient to salvage their property and discontinue the business rather than submit to further injustice. Such discontinuance of an established utility service would be very much against the public interest and its possibility should be avoided by restricting routine payments to investors, to interest and dividends only.

The writer finds it helpful to think of the public service problem as involving three distinct interested parties instead of the two parties ordinarily recognized in discussions, namely, the public and the investor. Between these two parties at interest the utility itself may be distinguished as a third party. The utility is by no means identical with the investor. It looks to the investor for funds as it looks to the public for patronage. It is no more subject to the command of one than to the other, unless it be that through regulating bodies the public has assumed a more dominant position. The utility should be looked upon as the custodian of property or an agent or trustee for both the public and the investor. As an agent it is an intermediary in all transactions; it receives the customers payments for services, disburses a part of them for expenses, taxes, etc., distributes a part to the investors who have furnished construction funds, and should retain a part for conservation of the property and for contingencies. The investor has no more right to demand a specific return from the utility for the use of his money than the public has to demand a specific kind of service. That the utility is or should be trustee of funds set aside for replacements to which the investor has no right is a point commonly overlooked

TABLE I

STUDY OF REPLACEMENT COSTS OF A TYPICAL UTILITY PROPERTY.

Initial property value \$10,000. Is composed of twenty units of equal value. The first unit is discarded and replacement made at end of ten years, second unit at end of eleven years and third unit at end of twelve years, et cetera. New property is acquired at rate of 10 per cent for twenty years, 7.5 per cent for thirty years and 5 per cent for fifty years. Each yearly increase represents the addition of twenty new units and these units are discarded and replacements made after the tenth, eleventh, twelfth year, et cetera, in the same manner as the original twenty units.

Year	Value at beginning of each year	Increase during year	Cost of replacing discarded property	Ratio of replace- ments to value at end of each year
1	\$ 10,000	\$ 1,000	\$ ..	..
2	11,000	1,100	..	..
3	12,100	1,210	..	..
4	13,310	1,331	..	..
5	14,641	1,464	..	..
6	16,105	1,610	..	..
7	17,715	1,771	..	..
8	19,486	1,949	..	..
9	21,435	2,143	..	..
10	23,578	2,358	500	1.93
11	25,936	2,594	550	1.93
12	28,530	2,853	605	1.93
13	31,383	3,138	665	1.93
14	34,521	3,452	732	1.93
15	37,973	3,797	805	1.93
16	41,770	4,177	885	1.93
17	45,947	4,595	974	1.93
18	50,542	5,054	1,071	1.93
19	55,596	5,560	1,178	1.93
20	61,156	6,116	1,795	2.67
21	67,272	5,045	1,474	2.08
22	72,317	5,424	2,121	2.73
23	77,741	5,831	1,832	2.19
24	83,572	6,268	2,516	2.80
25	89,840	6,738	2,266	2.34
26	96,578	7,243	2,993	2.88
27	103,821	7,787	2,792	2.50
28	111,608	8,371	3,571	2.97
29	119,979	8,998	3,429	2.66
30	128,977	9,673	4,271	3.08
31	138,650	10,399	3,615	2.42
32	149,049	11,179	4,386	2.74
33	160,228	12,017	4,728	2.74
34	172,245	12,918	5,097	2.75
35	185,163	13,887	4,995	2.51
36	199,050	14,929	6,344	2.96
37	213,979	16,048	5,884	2.56
38	230,027	17,252	6,828	2.76
39	247,279	18,546	7,362	2.77
40	265,825	19,937	8,440	2.95
41	285,762	21,432	8,029	2.61
42	307,194	23,040	9,640	2.92
43	330,234	24,768	9,316	2.62
44	355,002	26,625	11,019	2.89
45	381,627	28,622	11,293	2.75
46	410,249	30,769	12,153	2.76
47	441,018	33,076	12,496	2.63

TABLE I
STUDY OF REPLACEMENT COSTS OF A TYPICAL UTILITY PROPERTY.
(Continued.)

Year	Value at beginning of each year	Increase during year	Cost of replacing discarded property	Ratio of replace- ments to value at end of each year
48	474,094	35,557	14,922	2.92
49	509,651	38,224	14,495	2.64
50	547,875	41,091	16,564	2.81
51	588,966	29,448	17,240	2.79
52	618,414	30,921	19,108	2.94
53	649,335	32,467	19,555	2.87
54	681,802	34,090	22,007	3.08
55	715,892	35,795	23,177	3.08
56	751,687	37,584	25,494	3.23
57	789,271	39,464	26,849	3.24
58	828,735	41,437	28,946	3.32
59	870,172	43,509	30,639	3.35
60	913,681	45,684	34,931	3.64
61	959,365	47,968	34,784	3.45
62	1,007,333	50,367	36,699	3.47
63	1,057,700	52,885	39,066	3.52
64	1,110,585	55,529	41,233	3.54
65	1,116,114	58,306	43,372	3.54
66	1,224,420	61,221	46,192	3.59
67	1,285,641	64,282	47,702	3.53
68	1,349,923	67,496	50,822	3.58
69	1,417,419	70,871	53,415	3.59
70	1,488,290	74,414	57,315	3.67
71	1,562,704	78,135	58,152	3.54
72	1,640,839	82,042	62,713	3.64
73	1,722,881	86,144	63,779	3.52
74	1,809,025	90,451	67,180	3.54
75	1,899,476	94,974	70,869	3.55
76	1,994,450	99,722	74,043	3.54
77	2,094,172	104,709	77,066	3.51
78	2,198,881	109,944	81,482	3.53
79	2,308,825	115,441	83,935	3.46
80	2,424,266	121,213	89,712	3.53
81	2,545,479	127,274	92,312	3.45
82	2,672,753	133,638	97,208	3.46
83	2,806,391	140,320	102,142	3.47
84	2,946,711	147,336	109,251	3.53
85	3,094,047	154,702	113,345	3.49
86	3,248,749	162,437	119,282	3.49
87	3,411,186	170,559	125,027	3.49
88	3,581,745	179,087	132,616	3.53
89	3,760,832	188,042	138,420	3.51
90	3,948,874	197,444	146,930	3.54
91	4,146,318	207,316	152,658	3.59
92	4,353,634	217,682	161,182	3.54
93	4,571,316	228,566	168,004	3.50
94	4,799,882	239,994	177,283	3.52
95	5,039,876	251,994	186,168	3.52
96	5,291,870	264,593	196,510	3.54
97	5,556,463	277,823	205,021	3.51
98	5,834,286	291,714	216,618	3.54
99	6,126,000	306,300	226,128	3.52
100	6,432,000	321,615	237,830	3.52

and which, if given proper consideration, would very much simplify depreciation studies.

It should be clear from the author's paper that any full pro rata accrual for replacements results in a reserve which, in a growing property, is never used. It may be of interest to note, in connection with the history of an assumed utility shown in the accompanying table, that the annual replacement requirements of this utility could be taken care of by an accrual without interest accumulations, started after the end of ten years, at the rate of 3 per cent for the next forty years, 3.5 per cent for the following fifteen years and 3.69 per cent for the final thirty-five years. Such accruals, entirely absent from the first ten years, not only take care of all annual requirements, but accumulate an unused reserve which is always slightly greater than the current annual requirements.

F. C. Merriell (by letter): The matters placed in issue by the recent papers on appraisal and inventory seem to be merely a reopening of what has always been a fruitless inquiry. The general nature of the decisions of courts indicates clearly that practise and present needs have far outrun the enlightenment of the judiciary in this matter. The only factor contributing in any great degree to the solution of the problem, which comes from the courts, is a grudging recognition that value is the matter in question rather than cost, and that generally, items of value are more various and inclusive than items of cost.

For the use of courts, commissions, and the operators of property, an accurate inventory of property is a necessity and if it can be maintained continuous, it has the added advantage and no mean one, that all the force of the operator will be educated in the business of appraisal. This is a lack sadly felt at present and the use of most inventories is greatly limited because of it. A case in point is the inventory of a large utility, with which the writer was recently associated. The necessary field force was so unversed in the elements of value resident in such property that the inventory did not at all meet the requirement which necessitated it, and had to be supplemented with much special field work to make it adequate. It was in the first instance, unusually accurate and complete as to quantity, but the saving grace of well trained and exercised judgment was not always apparent in the first listing. A continuing education in this important branch of engineering, will quite materially assist to a better appreciation of how constituent parts of property account may best be identified in inventories, and more important still, it ought to increase the knowledge of how best to apply, and when most economically to expend renewal and maintenance funds.

In his paper Mr. Loebenstein sets up a number of paradoxical cases, because he makes his appeal only on the basis of physical cost and not upon the basis of value. In order, if possible, to join the issue let an extreme case be cited.

A pole line has been built through a desolate country and provides service between the communities at its ends. It is no matter for consideration whether the property shall have been a wise investment or not, but for a specific case it may be assumed that the service is adequate and that the projectors are making a profit. Every part of the property has however, suffered a lessening from its merchant price, by reason of the handling incident to erection, and by its removal from the regular channel of trade to its present location. Thus early it begins to appear that the merchant price has ceased to be a criterion of its value, even as property merely, and the charges which have been added to the merchant cost, while necessary for the specific service are in a very real way penalties against that cost or price when all the factors going to make its condition purely as property, are considered.

The country being desolate and uninhabited, it may very well be, indeed, that the property has no commercial worth whatever, no matter what its physical state may be. Many such lines exist today which cannot be dismantled, should such a thing be contemplated. The poles are not numerous enough to pay to gather them for firewood, at the expense of the labor per pole involved. The more durable units of property cannot be sold for the cost of their collection. Irrespective of the physical cost or condition therefore, this property is quite worthless as such and neither additions to it nor extensions nor enlargements of it will in any case increase its worth as property, in its location. In this case it appears that the criterion of the value of the property is not its worth as so many units of various physical things, but in its opportunity as a conception and its adequacy as the realization or embodiment of that conception.

Therefore the physical cost is an element only in so far as it enables the entrepreneur to demonstrate that he has done an adequate thing economically and that no penalty ought to be levied against him for the cost he has so far incurred because he is supplying an obvious need; and further that this physical cost together with all the other things he has done, appraised at their proper price, which make the property a utile and reliable public institution, are to be included in determining its value.

It has been attempted to show that the physical cost or condition is really a minor factor in arriving at value, and if that inference can be drawn from the extreme case cited, what follows may seem logical. The physical cost having been admitted as one, and not the only, element of value, and specific condition being a mere derivative of the course of all things physical and the fact of their existence, a further assumption is taken. If it was worth for the original purpose of the undertaking, all it cost to place the various units of property in their present position and use, how can it be said from that time each such unit began inexorably and without qualification to become of less worth. The fact which is well known and a stubborn one, that nearly

every kind of property passes through a long period after its first utilization, when the value of its service does not appreciably lessen, is vital here, and points to the conclusion that the character of its use and the length of time it will continue to render satisfactory service, are the real criteria of its value and that physical appearance or condition is of little moment, except as it is the visible evidence of care and forethought, (or the lack of these) in maintaining the property.

The fact that renewal or replacement would be necessary did not in the first instance surprise the entrepreneur, for he accepted these things as one of the necessary risks or expenses of his business. He has never charged himself with the duty of creating a certain standard of appearance in his property to betoken a satisfactory condition, but has rather given his best perception to the effort to detect the first falling off from the highest standard of service, and has esteemed the deterioration of his property to be first betrayed by its failure to render that high type of service. He is not and never can be interested in an attempt to ascertain what percentage of condition as merchant property his plant has reached, but he is vitally interested if it appears that he must increase its facilities or replace some of its units to keep it doing what is required of it.

If he be called upon at any time to evaluate the property, it is generally agreed that he has a right in its physical condition, which might be even better expressed if it were said that he had a duty to make those changes and renewals which will serve to maintain the standard of its usefulness. If he has accumulated funds for all the charges in reasonable prospect, he ought not to be said to own less than he formerly did. If he sell his property he will expect to receive the full price of it, including the amount of his provision for the future or he will take the sum he has so set aside as a part of the purchase price and the purchaser will thereupon have to set up a similar fund in order properly to administer it. Current practise thus illustrates that the concept of depreciation cannot make its way against the logic of actuality. And the property, which, having no provision for proper renewals and needing them, is sold, suffers in price to exactly the degree in which it has been neglected, thus proving in too many cases that the protection of regulation has not at the present reached that bi-lateral efficiency which has always been so strongly urged for it.

The projector, when he undertakes the business has certain definite aims: on the one hand to supply such a commodity as will be acceptable to his public; on the other to gain as much as he may; and as a corollary of the latter he expects nothing else than that the business shall maintain all the necessary charges as well as the profit he desires, and that consensus of opinion called good practise, supports him in the idea that he ought, if he can, to make renewals and replacements in the ordinary sense from earnings, inasmuch as these are ordinary things, to be

ordinarily met. If it is right therefore to take from earnings to make good these things, it is wrong to contend that the earnings so taken are a penalty against capital and reduce it by so much. If the provision is not made, the capital is indeed subject to reduction in the amount required for—what? To replace any fixed percentage of physical condition? By no means. To restore the service. If it were possible, there could be nothing more desirable than a uniform method, which could in fairness be applied, to assure that there was the proper intention on the part of the projector to continue his effort to give adequate service, which is the end really to be served by such provision, but experience demonstrates that uniformity is not in any very immediate prospect as a solution in this matter.

This view of the matter of so-called depreciation is not a new one, the writer having first formulated it to his own satisfaction in a private report some five years ago. As long as four years ago the receiver of a large utility defended and made good his defense of the attitude that he would not recognize any scheme of artificial penalization in lieu of his forethought and skill as a manager. A discussion of the whole matter from quite a similar viewpoint and with more attention to the mechanism of the scheme was published by Mr. C. E. Grunsky in Vol. LXXIX *Trans. A. S. C. E.* Finally it must be said that much of the difficulty of the whole matter at issue will be solved when it is recognized as a basis, that projectors, as corporations or the creators of corporations, are not willing to accept cheerfully any less fairness than any other component part of the public is willing to have.

J. Loebenstein: Referring to Mr. Nash's discussion, I call attention to the fact that when appraisals are made and estimates of requirements for future renewals desired, these estimates are made on the assumption that end of growth has been reached. Our predictions of what will be necessary in the future are based on what we know of the past. It will certainly be necessary to revise our estimates from time to time, but these revisions will in turn be based upon the past.

The Curve VII, which Mr. Nash notes, is based on the assumption that end of growth has been reached just as is Curve VIII.

In Mr. Merriell's discussion the statement is made: "If he sell his property he will expect to receive the full price of it, including the amount of his provision for the future or he will take the sum he has set aside as a part of the purchase price and the purchaser will thereupon have to set up a similar fund in order properly to administer it."

In my paper I tried to show what factors should be considered and in what manner the funds above referred to should be gathered. This cannot be done without some projected basis of renewals, based on the physical cost which Mr. Merriell considers only a minor factor.
