first place, as I pointed out in *Invisible Barrier* (p. 158), there are secondary factors, such as the variations in crop conditions and technological advance, which must be added to the primary curve of the investment and profit cycle. In the second place, in the sentence quoted by Mr. Price from Burns and Mitchell, those authors must, especially in view of their own chart, have meant by the sine curve the simple $y = a \sin x$, whereas in my paper in SCIENCE it is obvious, from my equations and the sentence following them, that I was not using the term sinusoidal in the same simple sense, but rather in the sense of a curve oscillating in the manner of a sine curve.

I disregard Mr. Price's reference to Marx. There is no kinship whatever between my theory and the surplus-value theory of Marx. Not that I would yield if there were. It is the province and duty of science to search for truth, and truth cannot be hemmed in by label or dogma. When that time comes science is doomed, and in whatever land.

Addendum: I have recomputed, in terms of a standard dollar, the schedule of figures in Table 3. For this purpose I used the 1929 dollar, but I am not contending that the standard dollar is a necessary refinement for this purpose. I am only presenting the figures (Table 4) for anyone who might so believe, in order to show that the results are substantially the same on that basis.

In arriving at these figures, the net income for each quarter was adjusted to the 1929 dollar on the basis of the wholesale price index. The increase in corporate investment for each quarter was adjusted to the 1929 dollar on the basis of the index used by Kuznets for gross capital formation in *Commodity Flow and Capital Formation* (Vol. 1, Table VIII-2).

The figure for corporate investment at the beginning of 1922, exclusive of inventories, was adjusted to the 1929 dollar on the basis of a composite index, for years prior to 1922, made up of average hourly earnings in the building trades with a weight of ¼; building materials prices with a weight of ¼; and the prices of metals and metal products with a weight of ½. The amount distributed to each year preceding 1922 is a percentage of the total increase in tangible fixed assets of corporations for the years 1922–29, inclusive, indicated by data for new manufacturing capital expenditures for plant and equipment. Such data go back only to 1915. The amount not accounted for in the years 1915–21 was treated as derived from the period 1905–14.

The inventory segment of total corporate investment as of the beginning of 1922 was, at current prices, already substantially on a 1929 price basis. The method of adjusting for each quarter only the increase in total tangible investment for that quarter is also substantially accurate in respect to the inventory segment because of the stability of the price level for the period 1922–29. No greater accuracy could be achieved because it would be impossible to state with the necessary precision the years from which each inventory total was derived, the portion priced at cost, the portion priced at market, etc.

It is clear that the conclusions derived from the figures prepared on a current-price basis still follow when the figures are adjusted to a standard dollar.

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Shipment of Animal Disease Organisms and Vectors

THE accompanying statement is self-explanatory. We have found, in cases of illegal movement of these materials, the scientific personnel involved were not acquainted with the requirements of law.

Since we are trying to reach scientific personnel with this information, we hope you will find space to include it in your journal.

HUGH C. MCPHEE

Bureau of Animal Industry, USDA
Washington, D. C.

NOTICE TO LABORATORIES, RESEARCH INSTITUTIONS, AND INDIVIDUALS STUDYING ANIMAL DISEASES

Permit Required to Import or Transport Interstate Restricted Animal Disease Organisms and Vectors

In recent months several instances of illegal movement of animal disease organisms and vectors in interstate commerce have come to the attention of the U. S. Department of Agriculture. Conditions under which restricted organisms and vectors can be moved under permit are explained in the Department's Bureau of Animal Industry Order 381, Part 122, entitled "Rules and Regulations Relating to Viruses, Serums, Toxins, and Analogous Products, and to Certain Organisms and Vectors."

Because of the inherent danger of such movements and the increasing need for taking every precaution against the spread of infectious animal diseases, all laboratories, research institutions, and others dealing with animal disease organisms and vectors are requested to comply with this order. Movements are allowed under permit only when such shipments serve the public interest and after ample safeguards are provided to protect against the further dissemination of such agents.

The Act of Congress approved February 2, 1903 (32 Stat. 792; 21 U.S.C. 111) confers upon the Secretary of Agriculture authority to make such regulations and take such measures as he may deem proper to prevent the introduction or dissemination of the contagion of any contagious, infectious, or communicable disease of animals from a foreign country into the United States or from one State or Territory of the United States or the District of Columbia to another . . . whenever in his judgment such action is advisable in order to guard against the introduction or spread of such contagion.

Under that authority, Part 122 of BAI Order 381, "Rules and Regulations Relating to Viruses, Serums, Toxins, and Analogous Products, and to Certain Organisms and Vectors," provides that no organisms or vectors shall be imported into the United States or transported from one State or Territory or the District of Columbia to another State or Territory without a permit issued by the Secretary and in compliance with the terms thereof.

Section 122.2 provides that the Secretary may issue at his discretion a permit when proper safeguards have been set up to protect the public. Application for such a permit *shall be made in advance of shipment,* and each permit shall specify the name and address of the consignee, the true name and character of each of the organisms or vectors involved, and the use to which each will be put.

All persons engaged in research involving the use of organisms or vectors as defined above should become familiar with the contents of this notice. Further information and applications for permits may be obtained by writing to the Chief, Bureau of Animal Industry, U. S. Department of Agriculture, Washington 25, D. C.

Parameters for the Description of Transition States

OF ALL the properties of the transition state, the free energy is the most valuable. From it may be calculated reaction rates and, consequently, the product composition of competitive reactions. In principle the free energy of the transition state may be calculated in two ways: (*a*) by statistical mechanics, and (*b*) by equations relating it to other measurable free energies. The former approach demands data as yet unavailable, and so it is the latter that is the more useful at present. The relationships with known free energies are rational but semiempirical.

Let F_r be the free energy of the reagents, F_p that of the products, and $F_\ddagger$ that of the transition state. Let ΔF_r, ΔF_p, and $\Delta F_\ddagger$ be the decrease in free energy (stabilization) of the reagents, products, and transition state for a change in a given independent variable, such as solvent or structure. A change from benzene to chlorobenzene as solvent or the introduction of a new substituent anywhere but directly at the site of reaction will serve as typical variations.

One rational first approximation is that

$$\Delta F_\ddagger = \alpha\,\Delta F_p + (1-\alpha)\,\Delta F_r \qquad (1)$$
$$0 \leq \alpha \leq 1.$$

This is chosen for the following reasons. We can expect the transition state to be intermediate between the reagent and product with respect to its free energy's sensitivity to changes in the independent variable, just as we expect it to be intermediate with respect to geometry and topology. If we assume that the transition state is *intermediate* in all its properties, including free energy changes except the absolute magnitude of the free energy itself, it is appropriate to use a linear combination of ΔF_r and ΔF_p as an approximation to $\Delta F_\ddagger$. We can also say that, if the transition state is intermediate, it will resemble the product less when it resembles the reagent more. This is expressed by Eq. (1) in which the parameter α measures the resemblance to the product and has 0 and 1 as limits, whereas $(1-\alpha)$ measures the resemblance to the reagent. We approximate the transition state by regarding it as a hybrid between the reagent and product states.

Since the quantity $\Delta F_\ddagger$ is not immediately accessible experimentally, it is desirable to rearrange Eq. (1). Let the superscripts 1 and 2 refer to two values of the independent variable (structure or solvent). Then

$$\Delta F_\ddagger = F_\ddagger{}^1 - F_\ddagger{}^2,\ \Delta F_p = F_p{}^1 - F_p{}^2,\ \Delta F_r = F_r{}^1 - F_r{}^2.$$

Eq. (1) then becomes

$$F_\ddagger{}^1 - F_\ddagger{}^2 = \alpha F_p{}^1 - \alpha F_p{}^2 + F_r{}^1 - F_r{}^2 - \alpha F_r{}^1 + \alpha F_r{}^2.$$

On rearrangement of terms, and introduction of the conventional symbols

$$\Delta F_1{}^\ddagger \equiv F_\ddagger{}^1 - F_r{}^1 \text{ and } \Delta F_1 \equiv F_p{}^1 - F_r{}^1$$

we have:

$$\Delta F_1{}^\ddagger - \Delta F_2{}^\ddagger = \alpha(\Delta F_1 - \Delta F_2).$$

If we now introduce an integration constant,

$$\Delta F^\ddagger = \alpha \Delta F + C. \qquad (2)$$

Eq. (2) deals with quantities $\Delta F^\ddagger$ and ΔF that are derivable from rate and equilibrium constants. It is equivalent to $\ln k = \alpha \ln K + C'$.

Whenever a plot of the logarithm of the rate constant of a reaction against the equilibrium constant for the same reaction gives a straight line, assumption (1) is justified. Furthermore, the slope of such a line is identifiable as a parameter that measures the degree of resemblance of the transition state to the products, as compared to its resemblance to the reagents.

Fairly precise relationships of the form (2) have been noted in a number of instances. For example, in the dissociation of hexaphenyl ethane, such a relationship obtains between the rates and equilibrium constants for the dissociation in a series of solvents (*1*). The value of α in this case is only about 0.2, indicating that the transition state resembles the ethane four times as much as it resembles the radical. The resemblance is probably at least partly geometric, the ethane and transition state both being sterically unable to interact strongly with the solvent. If so, it is likely that in the transition state the incipient radicals have not flattened out enough to acquire much resonance energy.

Better examples of relationship (1) are provided by Brønsted catalyses. Hammett has shown (*2*) for one case of the Brønsted relationship between the rate constant and the ionization constant of the catalyzing acid that there is derivable a linear relationship between the log of the rate constant and the log of the *equilibrium constant of the same reaction* (not just the acid ionization). The same appears to be true for most Brønsted relationships. From the slope of the Brønsted relationship it is therefore possible to calculate α. The variable in these relationships is the structure of the catalyzing acid.

There are several possible applications for α once it has been obtained. The value observed may be incompatible with one of several otherwise possible reaction mechanisms, thereby eliminating that mechanism. For example, consider a reaction thought to involve proton transfer $A^- + HB \rightleftarrows AH + B^-$, a fairly usual rate-determining step. A rough estimate of α can be obtained from the following consideration: A transition state differs from ordinary molecules in that