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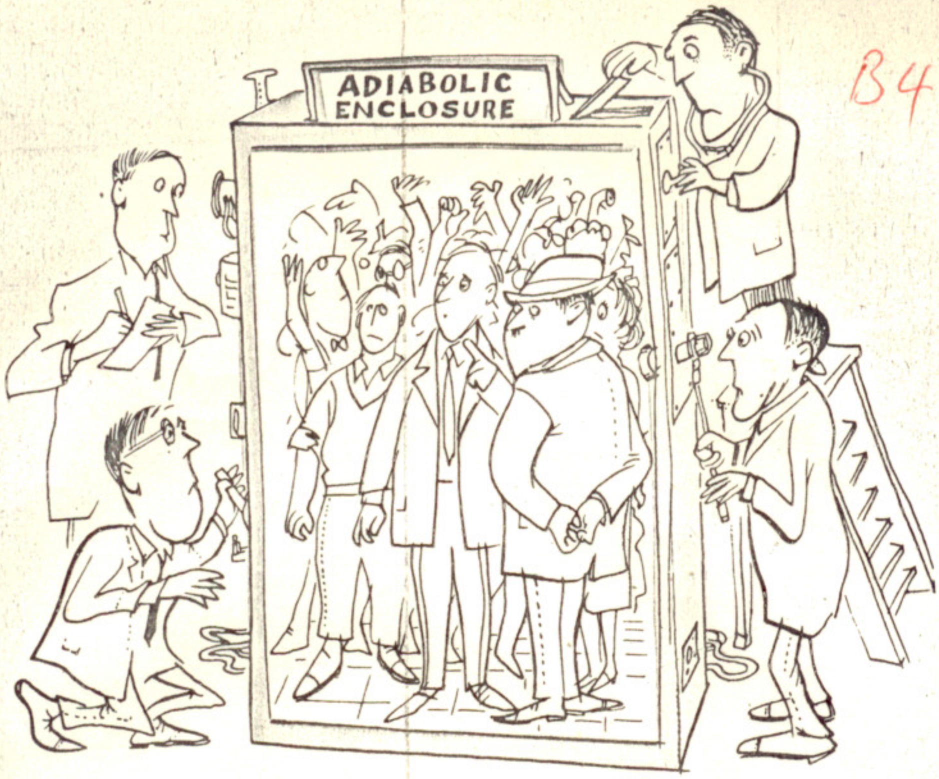
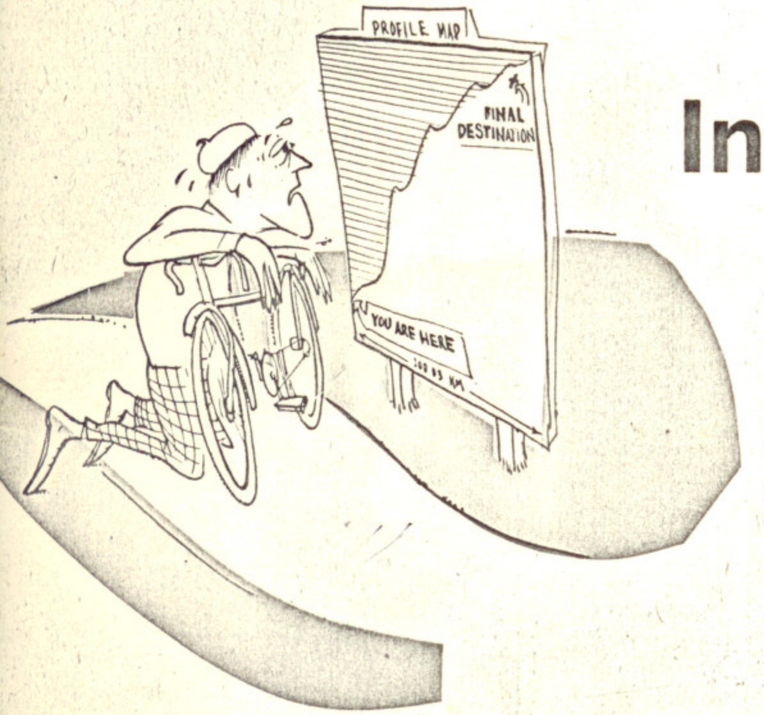
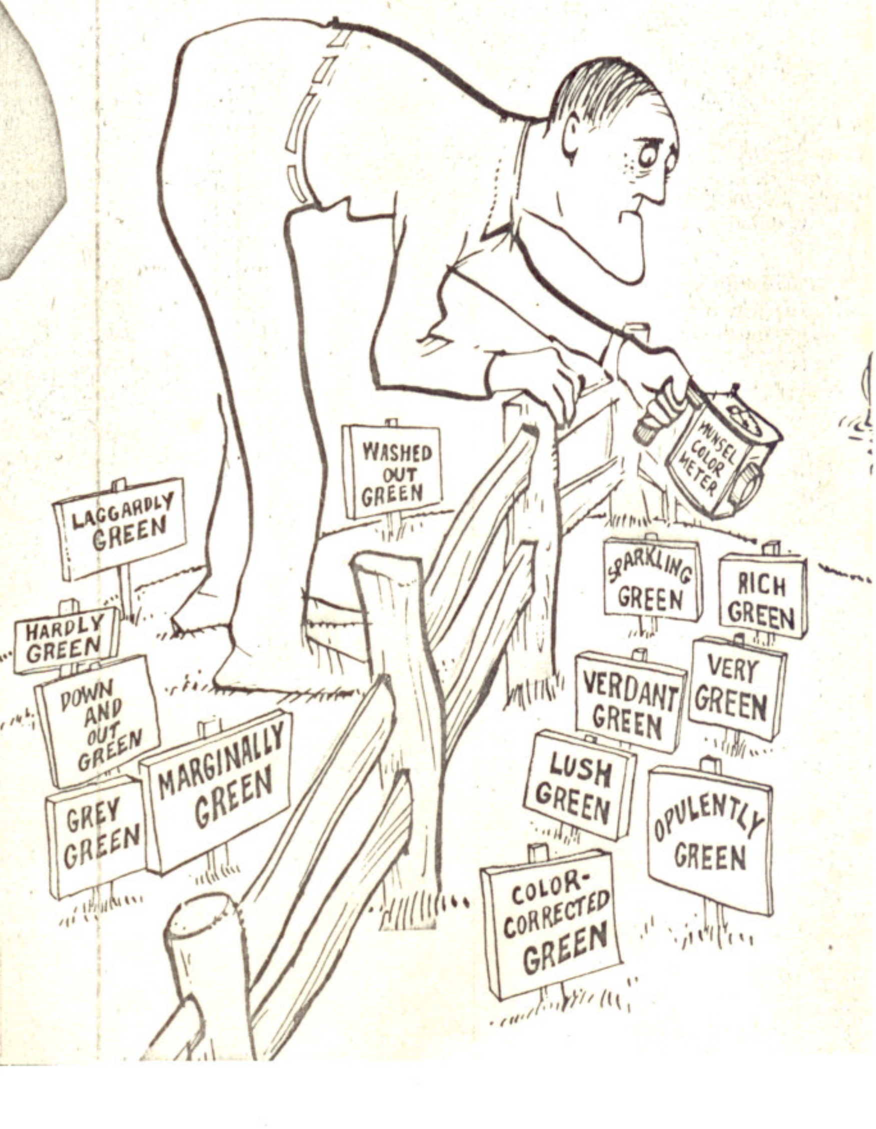
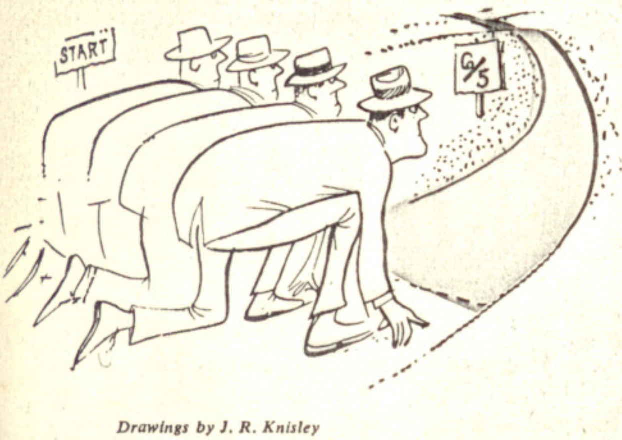


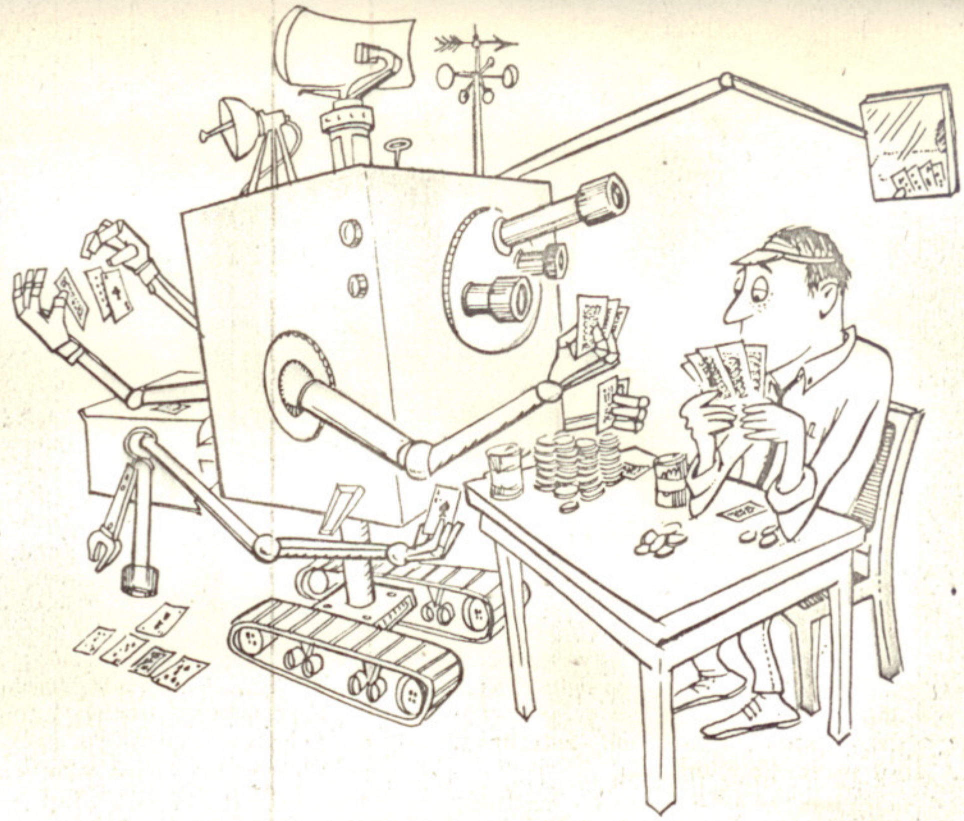


Introducing a new





Drawings by J. R. Knisley



life science—biotodynamics

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Representing the ultimate line of inquiry in the life sciences, biotodynamics is that science concerned with observable facts of the human condition.

While human behaviour has been subjected to intensive scientific study, the wider field of the *human condition* is still largely in the hands of metabiologists—novelists, spiritual philosophers, and psychologists.

The theory presented here may seem irrelevant to such physiological questions as why we lift our foot if we tread on a tack, but its relevance becomes more and more obvious as we move into the realm of real-life conundrums, such as the predominance of up gradients when cycling, and why the grass is greener on the other side of the fence.

The proverb alluded to is one of thousands of a similar general tenor. We feel instinctively that there is some influence or power over the human experience that is universally binding and limiting.

The object of biotodynamics is to determine the laws governing the operation of this universal force, and to use the laws in explaining and predicting the course of events during human life. In the long term, we hope to examine all spiritual theories, philosophies, and proverbs in the light of our new knowledge. It should be possible, at last, to judge them objectively and accept only those found in accord with the laws.

This is not the place to attempt the formal proof of all the propositions. We first simply state the forms in which we currently apply the qualitative laws and then proceed to an account of an important quantitative investigation. It is here that the success of the theory will be determined, but the experiential work is held up by genuine conceptual difficulties and, in turn, the lack of accurate data hampers theoretical progress.

We regard ourselves as most fortunate in coming across this very unusual problem (calling only for the ability to count) at an early stage of the work.

So far as we have progressed, the laws of biotodynamics appear necessary and sufficient to express all the fundamental relationships. The qualitative correctness of the laws is guaranteed by the experiential work of the authorities cited. Definitions are hardly appropriate, but it is necessary to explain some of the terms used.

A "biotodynamic system" is sim-

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Damon Runyon: "Everything in life is six to five against"

ply the subject of current interest, be it a group of people, or an individual, or a group of inanimate objects or abstractions.

Such a system is said to be within an "adiabolic enclosure" in the absence of any stimulus tending to make the system influence the outside world—a Maxwellian microbe, a personal demon, a creative leader, a spark of genius, or whatever other name may be given to what is really one phenomenon occurring in diverse circumstances.

An individual may be viewed either as a complete system in himself "from the inside," having regard to his personal history, feelings, and conflicts, or, "from the outside," as a member of a group, considering only his functions in this relationship.

There need be no conflict between the two approaches, but one must avoid confusion in the limiting case of the group reduced to one person. The "input" T to a system is taken to include all the forms of expenditure upon it, i.e. money, manpower, space, time, energy, and personal effort. The effects which it produces on the outside world are the "output" Q of the system.

First Law (Parkinson[1])—(*a*) *A sufficiently large biotodynamic system within an adiabolic enclosure produces no effect on the outside world.* The expenditure upon it of a given amount of input results in an equivalent change in the internal tension U, independent of the actual form of the input. The internal tension U is a function of state.

It will be seen that a biotodynamic system differs from the analogous physical system in that its components are more ready to exert pressure upon each other than upon the enclosing wall. However, preoccupation with internal affairs is not entirely unknown in the physical world; for example, it is manifest in the way in which real gases depart from ideal behavior. (Note how real life impinges even on physics from time to time.)

To pursue the physical analogy: It is commonplace that whereas the behaviour of a large group of molecules is accurately predictable according to Newtonian mechanics, a single molecule or subatomic particle is not subject to these laws. Its behaviour can be predicted only in terms of probability. In the same way, the behaviour of a very small biotodynamic system appears quite different from that of a large system. We may think of it as producing effects upon the outside world by a means analogous to the "tunneling" of electrons.

Whatever the mechanism, a modified form of the first law is required to encompass small systems: (*b*) *The probability that a biotodynamic system (within an adiabolic enclosure) will produce an effect on the outside world is an inverse function of its size.* We do not know the form of this function. Form *a* of the law is a special case of *b*.

The content of this law is established by Parkinson[1]. The historical reversal, by which this law was the last to be discovered, is presumably the chief reason for the delayed development of biotodynamic theory.

Second Law (Runyon[2]). Account is now taken of the natural cussedness of things in general. The function C is defined as,

$dC =$ [redacted] dT/φ,

then: *The total cussedness of any complete system can only increase or remain constant.* That is, $dC/dt \geqslant 0$, where t is time.

The identification of natural cussedness with the function C is not established with certainty. However, C will be seen to have many of the properties of cussedness, and no real difficulty has arisen as a result of this assumption.

Third Law (Thurber[3]) — *The cussedness of any complete system can only increase or remain constant. A maximum, therefore, constitutes a state of no further change.* The word "equilibrium" would not be appropriate here because of the implication of the phrase "no further change" in a biological setting.

Thurber saw this very clearly. His words, which form a complete statement of the third law, are, "When you stop suffering you'll *know* you're dead." In our terminology, $dC/dt > 0$ is to be equated with life and all its vicissitudes, clearly $dC/dt = 0$ ($C = C_{max}$) corresponds to death.

Our recognition of these identities came as a revelation after a long period of unproductive effort. Suddenly, we had in our hands a theory that appeared, in form, to be able to account for the rigour of life, the arrow of time, and the inevitability of death. The second law had formerly seemed merely empirical, now its meaning was made plain. The position of the cynic and pessimistic philosophers was entirely justified.

So far, however, the qualitative laws have proved disappointing in formulating hypotheses for direct experiential test. Their generality and simplicity carry the corresponding penalty of imprecision.

It is on the basis of the following statement that we defer to Runyon as the first to express clearly the ideas of the second law:

"Everything in life is six to five against."

He is even attempting to put a quantitative form on the relationship. We may write

$$\int_{t_1}^{t_2} d\ lnC = ln\ 6/5,$$

an astonishingly bold prediction for

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James Thurber: "When you stop suffering you'll know you're dead"

the time at which it was made. That it should have been overlooked need occasion no surprise, since even now the data are insufficient to permit a full, quantitative assessment of its value, although the "bus-bunching problem" soon to be described shows that the ratio 6/5 cannot hold universally.

In general, we write the Runyon factor, $R = C_2/C_1 > 1$.

Casting the second law in this form has the remarkable result that it demands the quantization of time—long suspected on the basis of experiments in physics, but never before shown to be inescapable.

The ratio of C at time t_2 to C at time t_1 is defined by a factor (a constant according to Runyon) that so far as we can tell is not a continuous function of time. The factor holds for any two specified instants that we regard as separated by a single time quantum.

Everyday experience confirms the validity of the concept. When we say that time drags, we are expressing our subjective response to a stationary time state; i.e. nothing is happening to the system of interest. The arrival of a time quantum changes the time state, or, in other words, raises the time state to a new level; something is happening to the system of interest, and we are all agog.

The occurrence of omnibuses in groups or bunches is a very well-known phenomenon; it is also an example of the more general rule that things (troubles, etc.) never come singly. We commonly accept that the most frequent grouping is three, and a few days' observation will convince you that this is true for buses also. It seemed possible that this fact would lead to a solution for R (the Runyon factor), and that the solution might provide a model for an approach to the general case.

Consider a bus service running at regular time intervals over a sufficiently long period of time (say H time quanta) and that during this period there is a total of N buses. Consider further the probability that a bus will come along in any randomly selected time state: common sense and nonbiotic mathematics suggest a probability $p=N/H$, but Runyon's uncommon sense gives $p = N/HR$ instead.

Suppose we were to stand and observe the whole sequence. We might expect to see a total of Hp buses; but such a test would constitute another real-life event, to

C. Northcote Parkinson: "Systems sufficiently large produce no effect"

Mark Gerson

which Runyon's factor is again applicable, and the apparent number of buses should instead be written, $N_n = Hp/R = N/R^2$.

This seems to demand a diminution in the number of buses returning to the depot, which would hardly escape the notice of those responsible, and is at variance with the conservation of mass. The difficulty is resolved if we accept that extra buses are formed which accompany those originally sent out, and can obviously only be distributed over occupied time states (conservation of reason).

This immediately makes clear the inevitability of bunching. The number of excess buses formed is clearly the number required to preserve the illusion that the correct number of buses is passing.

Over a period of H time quanta, let the correct number of buses be n, and the number of excess buses be X. In the above general equation we replace N by the term $n + X$, then,

$$N_a = n = (n + X)/R^2,$$
$$X = n(R^2 - 1).$$

A brief digression is necessary to discuss the nature of the excess buses. These are presumably high-energy, heavy particles (busons?) of short mean life—so short that they do not affect the accounting of the Omnibus Company. In attempting to identify them on the road we were at a loss until we began to wonder about the numerous class of buses that flit past, either totally empty, or, apparently, with a capacity load, and that never actually stop to pick any one up.

We propose simply that these "ghost" buses are identical with the "excess" buses demanded by theory. Direct experiential test of the theory should be possible by determining whether the observed proportion of "ghost" buses is in accord with that predicted.

The bus problem lends itself to a direct calculation of the limits on R. There is only one way in which a bus can be added to a solitary bus to form a pair, three ways of adding a bus to a pair to form a bunch of three, two ways to form a group of four from a three (six ways from a pair), and so on. The relative probabilities of each multiplicity can be written as follows:

$$p_2 = 1 \times 2! \times n(n-1) \ldots (n - X + 1),$$
$$p_3 = 3 \times 3! \times n(n-1) \ldots (n - X + 2),$$
$$p_4 = 6 \times 4! \times n(n-1) \ldots (n - X + 3), \text{etc}$$

Then, $p_3 > p_2$ when $3 \times 3!/2! > (n - X + 1)$, and $p_3 > p_4$ when $(n - X + 2) > 6 \times 4!/3 \times 3!$. Thus, p_3 is larger than all other probabilities when $9 > (n-X+1)$ and $(n-X+2) > 8$. Since n and X must have integral values, we find $n - X = 7$, whence it follows that

$$R = \sqrt{(2 - 7/n)}.$$

This result holds only for values of n greater than 7 (for smaller values of n, X would be negative or zero). R is found to lie between limits of 1 and 1.414. Runyon's estimate of 1.2 is close to the median, but must be regarded as optimistic for many applications, since for higher values of n the R values pack into the upper end of the range.

The remarkable and interesting feature of this work is that R should depend upon n (the number of states at hazard). Ordinary statistics suggests that one's chances at, say, roulette are unaffected as the number of attempts increases. The above result leads us to expect that our chances actually become very decidedly worse, in good agreement with experience, and accounts ideally for so-called beginner's luck. Runyon's value for R corresponds with $n = 16$. A useful check on the calculation could be made by finding the most frequent number of horses in a race in the United States of America at the time when he was writing.

References

1. C. N. Parkinson, *Parkinson's Law*.
2. D. Runyon, *Runyon on Broadway*.
3. J. Thurber, in an interview on *Tonight* (B.B.C. Television).

I think the analogy will prove to be valid. University officials who are responsible for such things should be made to realize that computers are important enough so that the cost of having one should be funded in the same way as improvements in the physical plant, and not charged as current operations. When viewed in this light, computer costs are much more in line with other research costs, as they should be. . . .

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BIOTODYNAMICS

Congratulations on the pioneering work on Biotodynamics [SR, 1 Apr '68, 36]. Unfortunately, the integral equation on page 38 implies a decrease in cussedness, which is contrary to the Runyon-Thurber laws. Interchanging the limits of integration would correct this flaw (since $t_2 > t_1$).

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I thoroughly enjoyed your article on the growing science of Biotodynamics. However, I feel compelled to point out a potentially misleading misprint: the equation (on page 38) defining the "cussedness function" C should read: $dC = dT/Q$. This is obvious from the second Law ("cussedness must increase", $dC/dt > 0$), when one recalls that the "cussedness" expresses the amount of *input* T required for a given *output* Q: *it is one of the basic laws of nature that the ratio of input to output must only increase, hence* $dT/dQ > 0$, hence $dC = dT/Q$.

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It is commonly supposed that scientists are a dozy lot, and to test this hypothesis the text of my article on Biotodynamics [SR, 1 Apr '68, 36] contained several deliberate mistakes ("Runyon" events, permitted to remain undisturbed in their native stratum). The results of this experiment are a triumph for our profession. Several colleagues were awake whilst reading the article and have written in to say so.

On page 38, column 2, the definition of C should read $dC = dT/Q$, and I am most grateful to Decker for spotting this and for his lucid exposition. Immediately below, the algebraic form of the second law should read $dC/dt \geqslant 0$, and in column 3 the limits of integration should be interchanged—as pointed out by Dolan.

How many readers succeeded in solving the problem set on page 39 (column 3, paragraph 2)? None of the answers sent in was entirely satisfactory. The correct solution:

Then, $p_3 > p_2$ when $3 \times 3!/2! > (n - X + 1)$, and $p_3 > p_4$ when $(n - X + 2) > 6 \times 4!/3 \times 3!$. Thus, p_3 is larger than all other probabilities when $9 > (n - X + 1)$ and $(n - X + 2) > 8$. Since n and X must have integral values, we find $n - X = 7$, whence it follows that $R = \sqrt{(2 - /7n)}$.

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AN ALTERNATIVE

From all that I have seen written on the "Schwartz amendment" in your magazine [SR, 29 Apr '68, 41] and others, it seems apparent that nearly everything has been said on both sides of the argument. Further, it seems fairly clear that the odds are heavily against the passage of the amendment. However, the fact that it has been brought to a vote by the APS is significant.

Personally, I am against the amendment because I believe it would present a dichotomy of interests to the APS membership and would certainly give the society a dual nature. However, it seems evident that some sort of forum is necessary for the scientist to express his opinion, other than scientific, on the various problems, social, economic, or otherwise, that are continually presenting themselves to mankind.

Therefore, I would like to suggest the formation of a society, perhaps a society for social, political and economic reform, through which opinions on various issues important to the country could be expressed. A prerequisite for membership in this society would be membership in any one of a number of scientific societies; e.g., the American Physical Society, American Geophysical Union, American Mathematical Society, etc. In this manner the scientific integrity of each society could be preserved, while providing a sounding board for opinions which truly lie outside of the charter of the society.

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