THE THEORETICAL APPROACH TO CANCER RESEARCH

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Most scientists work in the realm of the experimental, although theoretical physics is a classic successful theoretical approach to unknowns. Presently, my area of study is in theoretical biology [1] and theoretical mathematical biology [2].

Conversations I have had with the late Linus Pauling led to my starting the Nevada Institute for Theoretical Medicine. Pauling believed that every medical curriculum should include a program in theoretical aspects. My good friend the late David Horrobin, who was the founder of the journal *Medical Hypotheses*, believed that most research should be theoretical and from selected ideas so developed, one would subject them to experimental testing. Thus, there would be relatively little expensive experimental research. Obviously, the reciprocal situation exists as noted by the ratio of experimental journals to the few theoretical ones. Nicolas Rashevsky of the University of Chicago made a bold attempt at establishing a program in mathematical biophysics [3,4].

So, one might suggest that the future direction of research (funding) should emphasize theoretical and mathematical directions.

There are just a handful of theoretical biology journals including the *Journal of Theoretical Biology* [5] and a few "think tanks" today such as the Institute for Advanced Study at Princeton which has in its School of Natural Sciences a subprogram devoted to theoretical biology. The Salk Institute also has a program in theoretical biology.

The future of theoretical approaches to biological problems should encompass n-dimensional arrays of thought experiments and explorative attacks on basic and medical problems, limited only by the limits of the mind. The future of theoretical biology/theoretical medicine lies ultimately within the interest in this area of science. That, in turn, comes from early education given by teachers who are able to instill such interest. There is always the problem of programming the student mind with too much

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existing knowledge and thereby not allowing creative innovation to occur contrasted with presenting not enough information to accomplish anything. The solution must result from the "art" of teaching science.

Of course, a few "success stories" always helps in getting public attention and perturbing funding in some particular direction. "Success stories," in the context here, might be defined as theoretically derived solutions to hitherto insoluble problems. In my field if one could create a generalized mechanism that would be basic to curing any type of cancer cell, then that would be a "success story." Experimental studies based upon the theoretical work would necessarily follow to confirm its efficacy. Having said this, it is not very realistic to suggest that such an ideal could be achieved. But one could attempt an approach to these ends by, for instance, modeling theoretical epigenetic mechanisms using a tumor that would lend itself, e.g., carcinoembryonic cells, to an induced redifferentiation process reversing a dysdifferentiated cell and so on.

Finding people willing to devote their lives to the study of advanced mathematics and advanced molecular biology will require some incentives to compete with the many other similar areas that exist. These other areas may be, perhaps, more lucrative or even more easily achievable. It may be necessary to interest persons not only in basic mathematics such as differential geometry, but also to push beyond certain limits. Thus, to create whole new worlds of analysis in, say as in our example, differential geometry with biological problems even to the extent of forming "gestaltic combinations" not found in either the mechanics of applied geometry nor descriptive biological systems at the level of present day paradigms.

In other words, hopefully, something new under the sun would come out of these efforts.

NOTES

1 Hancock, R.L., series of papers in *Medical Hypotheses,* Bruce G. Charlton, editor in chief, Amsterdam, The Netherlands.

2 Hancock, R.L. and Zhong, C.K. (eds.), (1994), *Theoretical Mathematical Biology*, Lanzhou University Press.

3 Rashevsky, N. (1938/1948), *Mathematical Biophysics: Pysico-Mathematical Foundations of Biology*, second edition, Chicago: University of Chicago Press.

4. *Bulletin of Mathematical Biophysics,* Rashevsky, N., editor, Society for Mathematical Biology, Published by Elsevier, Ltd., Amsterdam, The Netherlands.

5. *Journal of Theoretical Biology,* Kirschner, D., Iwasa, Y., and Wolpert, L., co-chief editors, Elsevier, Amsterdam, The Netherlands.