

Wealth Creation and Science Research : Science Research, the root of wealth in our Knowledge Society, is endangered

Elemér E Rosinger

*Department of Mathematics
and Applied Mathematics
University of Pretoria
Pretoria
0002 South Africa
ee.rosinger@gmail.com*

Dedicated to Marie-Louise Nykamp

Two vastly different historical stages in wealth creation are the traditional one based on agriculture during past millennia, and the one based on science research in our present globalizing knowledge society. The differences happen to be so considerable, and the emergence of the second stage relatively so recent, that the awareness of the full range of consequences regarding the proper pursuit of science research, which is the root of wealth in our knowledge society, is missing to an extent that may, even in the medium term, seriously endanger the sustainability of modern human society.

Here is presented a brief account of some of such dangers, following which a parable, entitled "Is it a mere story ?", can be found, a parable which, hopefully, need not become a reality as well

For several millennia, prior to the industrial era, the main source of wealth for most human societies had been agriculture. Learning to work in agriculture had not required any formal instruction. Instead, the respective knowledge was simply acquired during one's childhood by step by step practice in one's family or social setup. Furthermore, a vast part of human society had been working in agriculture. Consequently, the ways of agriculture had been rather transparent to nearly everybody, including those in the various social elites.

Nowadays, with the emergence of the knowledge society, those who are involved in its science research or high-technology activities must possess corresponding formal education in science or technology. And as it happens, due among others to ecological constraints, the main source of growth in social wealth can only come from application in technology of ever new research results in so called hard sciences, among them physics, chemistry, biology, etc., and of course, mathematics, which nowadays underlies much of such sciences.

The inevitable and unfortunate effect is that the ways of science research, which is thus the root source of growth in social wealth, are hardly at all transparent to a vast majority in our societies, including various elites, be they in politics, business, culture, the media, and so on. Consequently, one should not be surprised to see that the ways science research is conducted turn out to be far from optimal, if not in fact, significantly deficient, and actually, to a worrying extent counterproductive.

Such a rather all pervading lack of transparency in the ways of science research may quite likely endanger in the medium to longer run the very existence of modern society. Several aspects of that danger can be mentioned, not necessarily in their order of importance, order which may differ in time and place.

1. The situations at the input and output of science research.

There has never been made in any larger human society a systematic study about the correlation between the increasing number of science and engineering graduates and their possibly decreasing quality. Such

correlations, even if empirically, are well known in fields such a professional sport, for instance, where quality, or the lack of it, has rather immediate considerable financial effects. In science and engineering, however, since the late 1950s, and across much of the world, there has been a massive increase in the number of graduates on all levels. The consequences are rather mixed however, as can be noted briefly in the following.

1.1. An ever growing difficulty has been experienced in colleges when teaching the mathematical discipline called Calculus 101, which ever since Newton, is the absolute prerequisite for learning science and engineering. Yet, no systematic study has ever been made about the percentage of humans who can learn Calculus satisfactorily, and during the usually available college time.

1.2. In consumer goods, such as cars, electronics, etc., or in weapons systems, there has been considerable improvements during the last several decades.

Regarding aviation, in the 66 years from 1903 to 1969, we went from the first ever few meters long and high flight by the Wright brothers of a contraption heavier than air at Kitty Hawk, North Carolina, USA, to the Apollo Program of NASA which sent a man to the Moon and brought him back safe to Earth.

However, in the 40 years since 1969, no progress of any comparative relevance has been made, or even attempted. And that stagnation is particularly clear regarding the methods of propulsion used in aviation or extra-terrestrial flights.

1.3. In fundamental science and technology, a strange picture has emerged. In the approximately 240 years between the 1680s and 1920s, we went from rudimentary ancient science and technology to Newtonian mechanics, thermodynamics, Maxwell's electro-magnetism, Einstein's special and general relativity, and quantum mechanics. And during all of that period at most a few hundred researchers of consequence were involved.

Since the 1920s, however, about 80 years have passed, thus no less than a third of the previous 240 years, and we are nowhere near to the next similarly major, and critically important step in fundamen-

tal science, namely, the unification of relativity and quanta. And that failure keeps going on while literally hundreds of thousands of Ph.D. researchers, be they physicists, mathematicians, and of other specialties are involved, and the amount of funds spent on the respective research are astronomical, when compared to the those used in the 240 years following Newton.

2. The situation with the management of science research.

A major shock in the management of science research occurred in the late 1950s, when under the perception of the imminent strategic threat of the so called "missile gap" in the favour of the Soviet Union, the USA authorities embarked on a massive expansion of science and engineering education at tertiary level.

Prior to that, the scientific community had been rather small. Consequently, in each major field people had known one another quite well.

One effect, which nowadays seems absolutely incredible, had been the way research papers were accepted for publication even in major scientific journals. Back in 1905, for instance, no less than four such papers of Albert Einstein had been accepted and published in top physics journals, although he was only 26 years old, not in an academic or research type position, and in fact, rather poorly seen by his former professors at ETH Zurich, one of whom, Hermann Minkowski, had called him "a lazy dog" during his student days. By the way, those four papers included those on special relativity, on the photo-electric effect for which he would obtain the Nobel Prize, and on Brownian motion, a paper which would finally entrench the view in physics of the existence of atoms.

A basic decision, starting with the late 1950s, regarding the management of the vastly increased number of science researchers was the introduction of "publish or perish", which soon proved to be but a "dog eats dog" level approach.

And that sort of sorry management approach got inevitably extended to the committees which approve academic appointments, promotions or tenures, as well as to the panels which distribute research grants.

That inevitability was of course inevitable

Indeed, given the ever increasing number of science researchers a larger and larger majority of whom could clearly not be, say in physics, yet another Newton, Einstein, Heisenberg, Feynman, or the anyone of the like, given the lack of transparency of the ways of science research to the vast majority of the population, and given the increasing and ever more narrow specialization in myriads of sub-fields, sub-sub-fields, and so on, which made science research lacking transparency even to most of science researchers themselves, the issue of the true merit of individual research contributions, let alone, of research directions, have simply become totally inaccessible to the means available to their day to day, or longer term management.

Ancient agricultural societies, among them those in Mesopotamia, are known to have ruined themselves by not being aware of the increasing degradation of fertile soil brought about by their given ways of its utilization.

The present day "fertile soil" from which alone the wealth of our knowledge society can grow is science research. And we appear to be equally blind to its despoliation, thus leading to its gradual ruin

But perhaps, there may be certain ways out from such a debacle

Certainly, the next parable may, either we like it or not, be the way that lies ahead

It is less clear, however, whether it may indeed be a way out as well

Is It A Mere Story ?

Somewhere in a civilization on a faraway planet, and at a certain moment in time, due to secondary, rather pressing and urgent utilitarian reasons, it was decided vastly and quite suddenly to extend the number of individuals involved in scientific research. Moderate funding could be provided at first, in the hope that the proceeds flowing from

the vastly increased amount of technological breakthroughs brought about by the massive scientific research may allow more generous funding later.

Science research, for the moment, was therefore seen as the most promising "Endless Frontier"

However, at the time, there could not immediately be found any reliable method for motivating so many young individuals to study hard, and do so for long years, and then keep up a life long research career.

Also the suddenly emerged vast amount of research output was not easy to evaluate with respect to its quality.

And then, as it happened, the decision was taken to institute the rather simple and raw "publish or perish" approach, according to which a minimal number of original research publications per unit of time would be the sine-qua-non for every researcher in order to be appointed and then remain, let alone be promoted, in his or her job.

Also, the respective "peer review" system to guard the gates of the scientific journals in front of what was quickly becoming a flood of submitted research papers was brought down to the level of "dog eats dog", in which the so called "blind refereeing" method was put to use. And it was "blind" only in one direction : the reviewers knew the authors of the papers submitted for publication, but not the other way round.

Not to mention that the "dog eats dog" aspect would emerge and entrench itself inevitably since the ever increasing amount of submitted papers could clearly no longer be reviewed by top scientists, thus second, third, and yet lower level ones would anyhow end up doing nearly all of the one way "blind" refereeing ...

And so, on that faraway planet, gone were by then the times when, like on our Planet Earth, a 26 years old completely unknown Einstein would submit in 1905 no less than three or four most revolutionary papers to a topmost physics journal, and that journal would publish

all of them in that very same year, and as it happened, most, if not all of them in the very same issue

In earlier times, research scientists had been rather few and far in between, and they had embraced that way of life out of a considerable inner motivation, often doing so in the face of serious adversities. And in each more major field, they knew quite well about one another. Those had been the times when only extraordinarily gifted persons had dedicated their life to scientific research, and had done so in response to a long lasting deep and intense inner call. They, therefore, had had all the motivation one would possibly need, and had been extremely careful not to damage their own reputation by going public with ill founded, dubious, let alone, erroneous ideas or results. And certainly, they would never ever think about plain cheating ...

Controversies, major wrong decisions, and even persecutions, would of course occur on occasion, but all of that had been within a circle of truly exceptional scientists

Now on the other hand, when so many were required to do scientific research, it was most likely that only a small fraction would - or possibly could - ever match the condition of those of earlier times.

After all, how many truly top talent in any specific field, including science, could any given generation produce ?

Mass education may be necessary, but certainly is not sufficient for producing exceptional talent

It is quite easy to set up a pizza parlour or hamburger joint at each street corner. But how many genuine "cordon bleu" chefs can one ever find ?

And then, soon, the situation reached a certain new balance.

The vast majority of those who would enter and remain in scientific research would somehow pass the minimum requirements of "publish or perish", and would for evermore keep straining to stay above that

rather low mark.

However, being the vast majority, they, with their mediocre ways, would create an unprecedented situation in scientific research. More often than not, they would set the standards, they would decide about the future directions, they would manage the scientific venture, and altogether, they would judge everybody and everybody's ideas in science, thus they would have both the proverbial bread and knife in their hands with respect to the careers of younger scientists. And needless to say, they would reject everybody who was not like them, and would do so either from sheer inability to understand those better than themselves, or due to mere resentment ...

In particular, they would reject those who - continuing the old tradition of the few exceptional research scientists - were so much better than that newly emerged vast majority.

And then, not much later, a strange phenomenon started to manifest itself. And it was subterranean, and hardly at all known in wider circles. Yet it got stronger and stronger as the time went by.

The few truly exceptional research scientists, those who in all times would alone be the ones to come up with the genuinely revolutionary and deeply consequential new ideas and results, were now delaying for evermore the publication of their very best research achievements. And in fact, often, they simply would not make them known in public in any way, not even by the slightest occasional hint.

And they could easily do so.

Indeed, for them it would be quite easy to satisfy the requirements of "publish or perish" on the prevailing mediocre levels. And in the rest of their time, they would turn to their own truly great ideas, and keep working on them mostly in a solitary manner, the manner which anyhow is quite naturally and inevitably imposed on great minds.

And there would even be some sort of universal or natural justice in this newly emerged situation.

After all, the social, material, or for that matter, official professional position of these few exceptional research scientist would mostly be determined by people outside of science, or at best, by one or another so called "peer" from the vast mediocre majority of research scientists ...

Therefore, these few exceptional research scientists would clearly realize that, on the level of society as a whole, science was not done scientifically.

And most likely, it could not be done so for a long long time to come, if ever ...

But then was such a state of affairs so much of a novelty ?

Yes, violence on that faraway planet has always been done violently
Yet, love was seldom done lovingly
Neither was art done artfully
And least of all has religion been done religiously

Thus why, indeed, wonder if, now, science was not being done scientifically enough ?

And then, protecting and developing true science could only be done mostly outside of the social enterprise.

And the few truly exceptional research scientists would be ready, willing, and able to do so

In older times, some of the few exceptional research scientists were persons of individual material means. And for them the pursuit of scientific research was in no way a means to earn a living.

Such times had, however, passed. And now, research scientists depended on a job and a salary, just like nearly everybody else.

Yet those few among them who were exceptional managed to a certain

extent to reproduce the very best of the old times when real science had been done ...

In that civilization on that faraway planet, however, the amusing mentality happened to prevail according to which whatever was socially important was supposed to be fully known and under control.

But then, no doubt, such an arrogantly ignorant, or rather, ignorantly arrogant view was bound to be mistaken

And amusingly again, there was hardly anything the celebrated and rather universally implemented managerial approaches could possibly do about the subterranean parallel development which emerged in that civilization, a development in which the very best of research scientists would in secret work, each on his or her own, on certain fundamental projects, and would not make public their respective very best ideas and results.

First, it took quite some time until science managers got sufficiently convinced about the very existence of such a subterranean parallel development. Indeed, their arrogantly ignorant, or rather, ignorantly arrogant ways made those managers firmly believe that absolutely all science researchers had been placed in a breakneck competition with one another, and also with themselves, a competition for the various meager perks science managers would be ready to offer. And then, it appeared simply inconceivable that science researchers would spend time on secret projects, projects for which they would never be able to get any sort of public recognition and reward.

This blindness of science managers further contributed to the strengthening of that subterranean parallel development. But the three main reasons such a development could take place at all were the following :

- due to the mediocre level of the vast majority of science researchers, the standards were quite low, and had to be kept low, lest much of that majority would have to be thrown out of science, a situation inconceivable in view of the utilitarian pressures,

- consequently, the few exceptional science researchers had plenty of time left, after they had fulfilled those low level standards,

- and those few exceptional science researchers had all the reasons not to declare publicly their very best ideas and results, namely :

- such contributions would most likely not be understood or appreciated by the vast mediocre majority of scientists, consequently, there would be a serious risk coming from the respective negative mass reaction,

- even in the highly unlikely case that such contributions would be appreciated, the mediocre rewards would be totally inappropriate.

And so it came to pass that, by the time science managers really woke up to the existence of that subterranean parallel development, there was precious little they could do about it

How did the things developed from that point on ?

Well, we may perhaps have to wait for some further reports on that strange civilization

Comment 1

Keeping major, and indeed, revolutionary scientific discoveries secret is not a completely unknown phenomenon.

Copernicus did that, in view of his more than justified fear of Inquisition.

Yet facing a far less formidable threat, Gauss, one of the two or three greatest mathematicians of all time, appears to have kept secret his discovery of non-Euclidean Geometry which, soon after, was rediscovered independently by Bolyai and Lobachevski.

In the case of Gauss his reluctance in making known his respective discovery appears to have been caused by his mostly correct assumption that the mathematicians of his time would have a massively negative reaction to it, thus he would seriously endanger his own considerable reputation.

Bolyai and Lobachevski, on the other hand, did not have to be concerned about such an eventuality, being at the time two quite obscure personalities among mathematicians.

Comment 2

Poor managers, and their surprising fellow travellers like Marx and his many ever more devoted Marxists

Yes indeed, poor managers, and among them, the modern science managers

In their theory of "surplus value" as the root of "capitalist or any other sort of profit, exploitation, and so on", the Marxists could never ever imagine the times when the fruits of production would extend so much beyond the physically measurable realms, as to become quite impossible to notice, let alone evaluate or estimate, by any of the available managerial approaches ...

And on that faraway planet that was precisely happening now with those ever few genuine science researchers

After all :

- there was an ongoing need for large numbers of science researchers,
- consequently, it was inevitable that only very few of them would be truly exceptional,
- and then, the standards had to be set at rather low levels, in order not to have to exclude too many of the science researchers, a situation

not acceptable due to utilitarian pressures,

- this created the opportunity for the few exceptional science researchers to have plenty of spare time, after having satisfied those low standards,

- and in their spare time, such exceptional science researchers would work on their own truly great ideas,

- and they would do so in secret and keep to themselves the respective results, in view of the high likelihood of not being understood, let alone appreciated by the vast majority of mediocre science researchers, not to mention the typically incompetent science management.

Yes, a new, a completely new era of "surplus value" was emerging

And it would for a long long time to come be indeed "surplus" to what society at large would know about, or for that matter, could benefit from

After all, some planets can be populated by rather strange creatures, can't they ?

References

- [1] Toynbee A : A Study of History. Vol I: Introduction; The Geneses of Civilizations. Vol II: The Geneses of Civilizations. Vol III: The Growths of Civilizations (Oxford University Press 1934) Vol IV: The Breakdowns of Civilizations. Vol V: The Disintegrations of Civilizations. Vol VI: The Disintegrations of Civilizations (Oxford University Press 1939)