How to judge how good a scientist is ?

Excerpted From Prof. J. P Sumpter of Brunel University London, UK, What makes a good scientist? Karl Fent as an example in Journal of Hazardous Materials, 376 (2019), 233–238 with some supplements

Edited by Hong LIU

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ABSTRACT

begin the understole laters to assessing the performance and impact of riceitushs, there appears to be to generally accepted way of doings. The research papers can be assessed by reviews notifies, that have every only or analyzed of the arthritists of a sectionskilly provide up or moleculation in many or the asystest 1 consister make up a good research activity. However, these are up ophisons only, they are often not apported by available quantitative, or every doing a section of the applicable control of the arthritistics of a section. It have the part of the arthritist of a device. Line the mapping these criterias the asystem and the asystem and the lass is contributed significantly to last choses discipline in a number of distinct ways, through both his leaching and his research. It herefore consider that he must be considered a very good scales. It, in the current end of admenting to quantity and here material and an interval the section of and when by lack of them is a hardware that the sensitivity of the sections attempting to develop, then utilize appropriately, objective criteria that are informative of a scientific to be much threader than the metrics correctly available.

1. Introduction

The question in the title of this paper is a very simple one and, therefore, a question that many people, especially existing scientists, might think they could answer with ease. But can they? If you asked scientists to name exceptional scientists, then names such as Albert Einstein, Charles Darwin, Marie Curie and Galileo Galilei would probably be forthcoming. If then asked why these people were considered the greatest scientists, they would probably say things like "their discoveries changed the world". However, if you then said "put aside the really great: what characterises a good scientist?", then these same tists may struggle to provide the criteria that make a good scientist. I certainly did, so I resorted to the World Wide Web (the invention of another exceptional scientist, Tim Berners-Lee) for help. Using the Web of Science Core Collection database and the search term 'what makes a good scientist' as a title, I was very surprised to obtain only 4 references published since 1970, none of which seemed to answer my question. Widening the number of journals searched from the Core Collection of the Web of Science to all journals in the Web of Science database yielded only 3 additional papers, albeit one very important one (see below). Then I broadened my search term to simply 'good scientist' in the title, which gave me 225 references. Yet none of these papers appeared particularly relevant to my quest; most just had the words 'good' and 'scientist' in their titles, and not always together. ce it appears that either the question in the title of this paper is of no interest to scientists - which I strongly doubt - or it is not as easy to answer as intuition might have one believe. The question posed by the title of this paper is really a social science and I am an experimental (eco)toxicologist, and hence

probably not the best person to attempt an answer to that question. In fact, the study more relevant to the topic of this paper that in an aware of [10] is published in a social science journal. That paper reports the results of a relatively small survey intended to identify the factors senior scientists use when judging the CA's of junior scientists. Once the associar scientists that frate the junior scientists, the attribution year, impact factors of journals, apout on journey scientists. The science scientists there is a science of the various factors in the authorship lists, prestige of institution, etc) correlated with the ratings provided by the science is journal, apout interviewing and association of the science of the various factors instructions, are and the scientistic science of the science factors. That finding was supported by the finding of another study [2]. Are we say exter at long scientistic science and contend science?

In contrast to those two studies [2,10], have not conducted a study to address the topic of this paper. However, having spent my entire career (over 40 years to date) ara scientist, have gained a considerable amount of experience in judging the quality of science, and hence scientists. I have reviewed many hundreds of papers submitted by other scientists for possible publication in scientific journals, and also reviewed a lot of research grants. I have read the opinions of other scientists when they have reviewed my papers and my grant applications. It have attended many scientific conferences, during which I must have been asked to judge the merits of many applications by scientists for promotion. Hence, whether conclusion of no the scientific fourdences whether conclusion by no scientific fourdences whether conclusions for many applications by scientists for promotion. Hence, whether conclusions for no the scientific fourdences whether conclusions for no scientific fourdences whether conclusions for other scientists for promotion. Hence, whether conclusions for no scientific fourdences and the science science and the science of parts. And I have been judging the science is the science science and the science of parts for the science science and the science of parts and the science science and the science of sciences and the science science and the science of sciences and the science science and the science of sciences and the science science and the science an

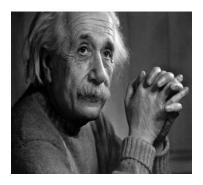
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Some exceptional scientists in public eyes

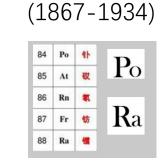


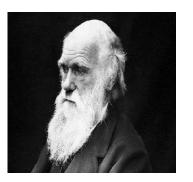
Albert Einstein (1879-1955)

E=mc²



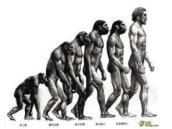
Marie Curie

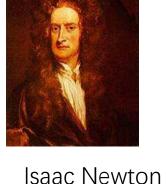




Charles R. Darwin

(1809-1882)





(1643 - 1727)

MPTIBUS SOCIETATIS

PHILOSOPHIE NATURALIS PRINCIPIA MATHEMATICA



(1564-1642)

Galileo Galilei

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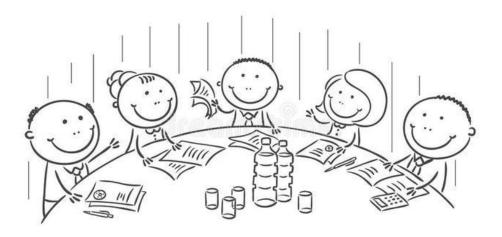
Because their discoveries changed the world and human's life

How can we judge how good a scientist is currently?



(1) Subjective opinions: made by the academic peers





Bias likely arises as we suffer so frequently in real life, as these were just opinions, not facts supported by evidence.

This situation was radically transformed in the 1970's: citation analysis was born

(2) The use of metrics: amount of papers, citations, h-index,

Who is the best research scientist? These are possible, not actual, metrics, but they are probably representative of productive scientists at different stages of their careers.

Position	Age (years)	Length of publishing career (years)	Number of papers	Number of citations	Average number of citations per paper	H-Index
PhD student	28	2	2	6	3	2
Post – doctoral fellow	34	8	9	54	6	4
Assistant Professor	38	12	15	225	15	11
Associate Professor	52	26	48	1,152	24	20
Full Professor	58	32	150	3,000	20	30
Retired Professor	66	40	220	8,360	38	46





(3) Research impact

- To lead to a major beneficial change in society is better than the esoteric research appeared to be of very little interest or relevance to anyone.
- Impact evaluation methodology itself has become an active and dynamic field of study.



However, this impact can take years, or even decades, to become apparent



Let the bullet fly for a while

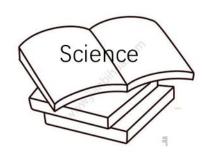


(4) Other outputs

- Articles in newspapers and magazines, and appearing on television and radio.
- Blog, tweets on Twitter
- Books







However, an outrageous scientific claim might cause asocial media 'storm', but be based on fabricate devidence, or no evidence at all.

Also the topics are unrelated to science, or the audience may

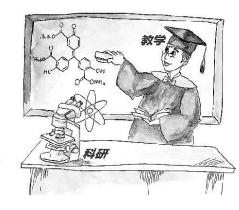
be of uninterest, even misled.



(5) Teaching

- Scientists based in universities are likely to do considerable amounts of formal teaching.
- Teaching sometimes contributed more to the legacy than the research and articles.







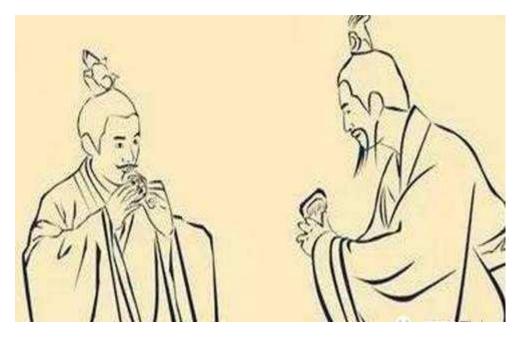
Unfortunately no simple–or even complex–metric has been developed yet that can identify and quantify the importance of teaching.



(6) Supervision and mentoring of juniors cientists

- One-to-one activities
- To ensures that the next generation of scientists will be well trained, from Ph.D. students.
- Some excellent research scientists are not particularly good supervisors Some excellent supervisors are not particularly good research scientists.

The best scientists are both.





(7) Leadership

- Individual's research is conducted within a team or an organization devoted to a particular topic.
- Someone, almost always another scientist, very definitely a good scientist, lead the team or organization.
- Leadership, very demanding and time-consuming.
- A good administrator, likely having little or even no time for their own research, protects other scientists from non-scientific issues, so that the latter can concentrate on their research.
- Leaders contribute in a more indirect manner, and contribution should not be underestimated.

However, quantifying this aspect of the contribution to the discipline is only possible subjectively; no metric available for scientific leadership.





(8) Appropriate mental characteristics (besides intelligence)

- Objectivity: open mind instead of letting existing prejudices influence thinking, unbiased
- Curiosity: the desire to understand something of interest; to be inquisitive about the world
- Vision: the ability to identify important new research topics, rather than follow fashionable topics, and then have the courage to initiate research on those novel topics
- Finishing something: knowing when 'enough is enough' on a topic, hence completing that project, then moving on to the next topic
- Communication skills: the ability to deliver public talks and publish scientific papers, in order to make others aware of research findings
- Coping with failure: persevering while regularly 'failing' is a prerequisite of any scientist
- Hard work: passionate about their research

Many have very balanced characters, enabling them to interact well with other scientists and allowing them both to lead scientific projects and collaborate with other scientists successfully.

(9) Integrity

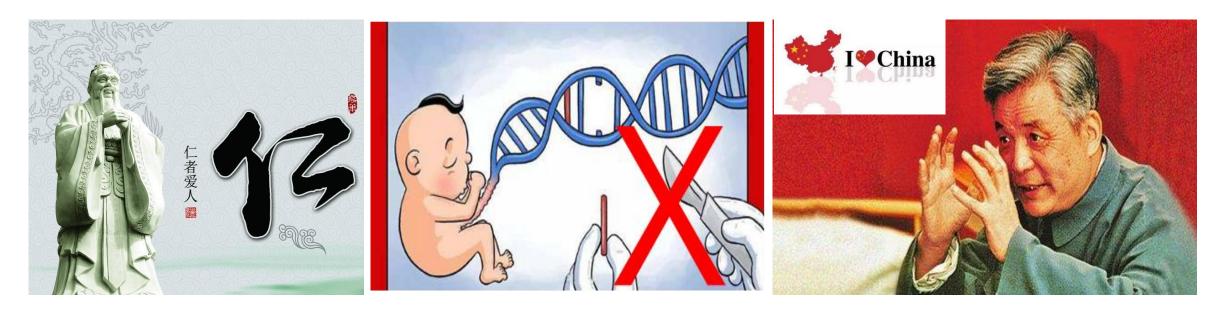
- Not published research of poor quality or irreproducible
- Not publishing negative results and/or exaggerating positive results, or fabrication of results
- Bias in the interpretation of results
- Hype and exaggeration, especially in the title and abstract
- Figures that distort data, or do not display it fully
- Failure to cite relevant papers from other scientists
- To omuch selfcitation
- Failure to mention any limitations to the study
- Conflicting interests not mentioned
- Rawdata not submitted as supplementary information
- Failure to analyse the results appropriately and accurately

Scientific integrity is such a crucial factor in science, then to consider it separately from other personal characteristics often possessed by good scientists.

No metric for integrity! But I don't believe that" or "that paper is very poor", or alternatively positive comments like "he/she doe excellent research" or " that is a very robust study".



(10) Humanism and patriotism (supplemented by this PPT editor)



Final thoughts: Most scientists should all aspire to being good research scientists, because only good research is of benefit to society. The advent of scientific metrics applied to the output of scientists has helped to add a degree of objectivity into the judging of scientists, but perversely it has also stimulated a range of poor scientific practices, as scientists try to 'play the game' to satisfy their paymasters, who often utilize metrics uncritically. Probably only further education and training can improve the current situation, and enable as many research scientists as possible to become good researchers.