are indexed in the *SCI*-CD version. However, the *JCR* covered 47 journals from India during 2000 (Table 2).

With this backdrop, one of us (NCJ) while presenting the paper in the IX International Conference on Scientometrics and Informetrics held at Beijing, the People's Republic of China during 25–29 August 2003, appealed to fellow participants to use *Web of Science* data while reporting the country data as it gives a 'true' picture of papers published as seen from the ISI database. There is a need to exercise utmost care to use appropriate dataset before making generalizations.

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Response:

I would be the last to criticize anyone for recommending caution in the use of these databases and the need to educate users in the significance of the differences in the various forms of *SCI*.

The objections to various aspects of the *JCR* data and other derivatives of the *SCI* come mainly from bibliometricians and not from general users. This does not mean that *ISI* should not seek to improve the data in one way or another. I have worked towards that end and I am confident that future versions of *JCR* and *SCI* or *WOS* will reflect the many improvements that can be made in such a large database. Various normalization techniques have been proposed in utilizing these data. Indian users, like all others, should not hesitate to make their constructive suggestions directly to *ISI*. I myself, like the authors, am just an observer and have often published warnings about the uninformed use of *JCR* or other data.

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On publication indicators

According to Satyanarayana and Jain[1] 'the scientific community is not satisfied with the existing quantitative indices like the *SCI* and its twin publication, the *JCR*'. I wonder how many scientists they polled to arrive at this conclusion. If this were the case, Thomson-ISI would have gone out of business long ago; in reality though the company is thriving and the revenue brought in by citation index databases and their derivatives is on the rise. Since the early 1990s, *SCI* has spawned half a dozen field-specific citation index databases (for neurosciences, biotechnology, materials science, etc.) and Thomson-ISI is now extending their database back to 1900 so one can trace the evolution of ideas over a much longer period. The idea that the cognitive link between citing and cited documents provides a far better handle for retrieving related documents than mere keywords was originally exploited by Gene Garfield in the early 1960s. It has since been picked up by other database producers and new services such as *CrossRef* have come up. If scientists were unhappy with *SCI*, these developments would not have taken place. The citation databases of ISI are used widely by scientists in many countries, as evidenced by the large number of subscribers. I myself subscribe to CD versions of three citation databases from the early 1990s. Besides, as *SCI* is a truly interdisciplinary database – which covers a wide range of fields spanning science, engineering and technology, agriculture and medicine, unlike subject-specific databases – it has gained wide acceptance among the science policy and indicators communities as well.

Satyanarayana and Jain[1] have expressed their dissatisfaction with the use of publication counts obtained from the CD-ROM version of *SCI* for measuring the publication output of nations. As pointed out in an earlier paper[2], both Robert May[3], a former President of the Royal Society and Chief Scientific Advisor to the Government of UK, and Noble Laureate Ahmed Zewail[4] have used publication data from the restricted-coverage version of *SCI* while making international comparisons of scientific research in the not-so-distant past, and both the *Science and Engineering Indicators* of the US National Science Board and the *European Report on Science & Technology Indicators* of the European Commission use *SCI* fixed journal set data regularly. These are not the only examples. Many other eminent scientists and well-known national and international organizations also use publication counts obtained from the restricted-coverage version of *SCI* to get a rough idea of the research output of nations.

Satyanarayana and Jain wonder which version of the database should be used – the CD version of *SCI* or the larger *Web of Science* (*WoS*) – when counting the number of papers originating from a country. How can both be right, they wonder. As Garfield and others, including yours truly, have pointed out time and time again, one has to use such indicators with caution. One must be clear what one is measuring and state how the measurement is made. After all, it is impossible to measure 'the research output of a nation as a whole' accurately. What we measure is usually a surrogate, viz. research papers published in professional journals. There are two definitional problems here, one pertaining to journals and the other pertaining to papers:

(1) How many journals are there? Do all serial publications count as professional journals? Can we count the science page in *The Hindu* and *The New York Times* or magazines like *Computers Today* and *PC Quest* as journals? Journals clearly differ in quality, and in the perception of a majority of scientists, including Indian scientists, *Nature* and *Science* are way

ahead of *Current Science* in the pecking order, and the *Journal of the American Chemical Society* is ahead of the *Indian Journal of Chemistry*. The impact factors of the journals in *JCR* correlate well with the perception of scientists. The actual journals covered in ISI databases keep changing, almost on a weekly basis, as can be seen from the announcements made in *Current Contents* and on the ISI website; titles are added and occasionally dropped – not arbitrarily, but on the basis of certain clearly enunciated criteria. That is why analysts prefer to work with fixed journal sets[2]. Stevan Harnad has recently estimated, after a scrutiny of titles listed in *Ulrich*, that there are about 24,000 journals, which collectively publish about 2.5 million papers annually[5]. Gene Garfield thinks that the upper limit of the number of science, technology and medicine (STM) journals would be around[6] 15,000. *SCI* (CD-ROM) indexes a selection of titles (3795 as seen from http://www.thomsonisi.com/cgi-bin/jrnlst/jlresults.cgi?PC=K&mode=print&Page=1), and the online version (*SCI Expanded* which forms part of *Web of Science*) a few thousands more (6084 titles as seen from http:// www.isinet.com/cgi-bin/jrnlst/jlresults.cgi?PC=D). The numbers of journals indexed by subject-specific bibliographic databases such as *Chemical Abstracts* (*SciFinder*), *Biological Abstracts*, *Mathsci*, *Inspec*, *PubMed*, *CAB Abstracts* and *Compendex* are of the same order of magnitude. Even the other major multidisciplinary database, *PASCAL*, indexes only about 5000 journals [http://www.cas.org/ONLINE/ DBSS/pascalss.html]. No database covers all STM titles.

(2) What is a research publication? Journals like *Nature*, *Science*, *BMJ* and *Current Science* publish news, views, opinions, editorials, book reviews, obituaries, etc. One would not normally consider these kinds of articles as research contributions. Generally, full (original research) papers, short communications (also called letters as in *Physical Review Letters*, *Physics Letters* and *Tetrahedron Letters*), notes and review articles (as in *Chemical Reviews*) are counted. Also, papers differ in length, volume and the quality of their scientific content and perceived value, as well as their impact on future research.

The numbers of papers indexed in the *Web of Science* (*WoS–SCIE*) will obviously be larger than those indexed in the CD version and the fixed journal set, for the simple reason that the *WoS* covers a larger number of journals. That will be true not only for India but also for other countries. In the case of India, the numbers will differ considerably because of the very large number of Indian journals (36) included in *WoS–SCIE* in addition to those indexed in *SCI*-CD (10); in 2002 *WoS–SCIE* has indexed 3982 papers published in Indian journals over and above the 1919 papers indexed in *SCI*-CD (Table 1). Indian authors might have published a few more papers in the nearly 2250 non-Indian journals that *WoS–SCIE* indices over and above those indexed in *SCI*-CD. Clearly, much of the difference in the number of Indian papers

Table 1. Indian journals indexed in *Web of Science* 2002 and *SCI*-CD

No.	Journal	Articles	Impact Factor
Journals indexed in both *SCI*-CD and *WoS–SCIE*			
1	CURR SCI India	706	0.6
2	INDIAN J CHEM A	251	0.407
3	INDIAN J CHEM B	265	0.398
4	INDIAN J MED RES	74	0.34
5	J ASTROPHYS ASTRON	34	0.175
6	J BIOSCIENCES	91	0.657
7	J GENET	12	0.583
8	NATL MED J IND	145	0.617
9	PRAMANA-J-PHYS	268	0.283
10	P INDIAN AS-CHEM SCI	73	0.317
	Sub-total	1919	
Journals indexed in *WoS-SCIE* but not in *SCI-CD*			
11	ALLELOPATHY J	35	–
12	ANN ARID ZONE	35	0.062
13	ASIAN J CHEM	341	0.201
14	ASIAN J SPECTROSC	24	0.465
15	B ELECTROCHEM	91	0.23
16	B MATER SCI	168	0.465
17	DEFENCE SCI J	53	0.093
18	ELECTRON INFORM PLAN	10	–
19	IETE J RES	88	0
20	IETE TECH REV	46	–
21	INDIAN J AGR SCI	107	0.042
22	INDIAN J AGRON	48	0.032
23	INDIAN J ANIM SCI	417	0.057
24	INDIAN J BIOCHEM BIO	50	0.294
25	INDIAN J CHEM TECHN	92	0.197
26	INDIAN J ENG MATER S	75	0.103
27	INDIAN J FIBRE TEXT	65	0.231
28	INDIAN J HETEROCY CH	108	0.168
29	INDIAN J MAR SCI	55	0.127
30	INDIAN J PURE AP MAT	201	0.085
31	INDIAN J PURE AP PHY	143	0.213
32	INDIAN VET J	395	0.043
33	J APPL ANIM RES	54	0.135
34	J CAMEL PRACT RES	33	0.055
35	J ENVIRON BIOL	72	0.153
36	J FOOD SCI TECH MYS	147	0.145
37	J GEOL SOC India	193	0.456
38	J INDIAN CHEM SOC	291	0.413
39	J PLANT BIOCHEM BIOT	25	0.388
40	J SCI IND RES India	102	0.176
41	NATL ACAD SCI LETT	37	–
42	NEUROL IND	152	0.173
43	P INDIAN AS-EARTH	46	0.269
44	P INDIAN AS-MATH SCI	48	0.097
45	SADHANA-ACAD P ENG S	47	0.153
46	T INDIAN I METALS	88	0.098
	Total number of articles	5901	

Web of Science searched on 2 February 2004. Journal abbreviations are as given in *Web of Science–SCIE*. Numbers of articles are for publication year 2002. (Searching *SCIE* for number of articles in a journal in 2002 by specifying 2002 in the period field locates only papers processed by ISI in 2002, which will include most papers published in 2002 and some published in 2001.)

indexed in the two versions can be attributed to the additional coverage of Indian journals in *WoS–SCIE*. Table 1 also lists the impact factors of these journals and it is clear that, with a few exceptions, they are not in the same league as the journals indexed in *SCI*–CD. (Some of these exceptions were indexed in the CD-ROM version of *SCI* some years ago but have been dropped since then.)

Thus, if we lower the threshold and include more journals, we will inflate the number of papers from India. But if we want to adopt an internationally accepted practice such as that used at US NSF–NSB, European Commission, UNESCO Institute for Statistics[7], OECD[8], Observatoire des Sciences et des Techniques (OST, Paris), Hungarian Academy of Sciences, and CWTS-Leiden, then we will end up with fewer papers for India. In any case, whenever bibliographic databases are used to count publications, one clearly mentions which database one has used.

The Science Indicators movement has generally adopted *SCI* as the major source of publication indicators. This movement started after the first Frascati meeting (resulting in the manual published in 1963) and later got a fillip when – in its 20th session in 1978 – UNESCO's General Conference adopted the Recommendations Concerning the International Standardization of Statistics on Science and Technology. In the early 1970s Francis Narin and CHI Research (then known as Computer Horizons Inc.), who use *SCI* data in their work for many governments and international organizations, started using the fixed journal set of *SCI*. Commissioned by NSF, CHI Research developed bibliometric indicators – primitive but, with international comparisons – for the *Science Indicators 1972* report, using *SCI* data fixed journal set (private communication dated 28 January 2004). OST, Paris considers *SCI* data 'currently constitute the world's primary sources of bibliometrics data'[7]. We would be wise to steer clear of a false sense of patriotism that may lead to the adoption of non-standard practices.

In their 1975 paper, Narin and Carpenter[9] reported international comparisons based on 492 journals for 1965–71, and 2143 journals for 1972. Afterwards, they periodically expanded the fixed journal set, and in recent years have also used an expanding set. Narin says, 'but I personally prefer doing trend analysis in the fixed set' (pers. commun. dated 28 January 2004). Thus, I used *SCI*-CD data for comparing publication outputs of India, China, Brazil and South Korea[10] by choice, and not because I was ignorant and unaware of the existence of the *Web of Science* – as was incorrectly concluded without any evidence by Satyanarayana and Jain. [In some ways, if *Web of Science* is accessible to researchers in several Indian institutions today, I was among the few who had worked hard for it since 1996. Incidentally, my association with Gene Garfield goes back to 1974 when as Secretary of the Indian Academy of Sciences I invited him on a lecture tour to Bangalore, and my association with ISI goes back to 1977 when I was invited to join the editorial board of *Current Contents*.]

Let me now address Satyanarayana and Jain's comment on the state of health (or decline) of science in India. The latest editions of both the *Science and Engineering Indicators* and the *European Report on Science & Technology Indicators* have commented on the decline of science in India, as reflected in publication counts[2]. Even if we use the *WoS–SCIE* data, the percentage share of papers from India in the extended set of journals would certainly be a better indicator than the mere number of papers. Data are provided for India and a few other countries for the years 1993–2003 in Table 2. One will see that India's share remains very nearly steady – with minor variations – whereas the shares of Brazil, China and South Korea have increased substantially.

The UNESCO Institute for Statistics has estimated that – taking 1990 as a baseline – India published only 89% of the number of papers in 1997. Corresponding figures for other countries and regions are[7]: China 170%, Latin America 136%, Industrial Asia 126%, Europe 110%, Oceania 107% and Sub-Saharan Africa 72%. India, North America and Sub-Saharan Africa recorded a fall, whereas most other parts recorded a rise.

As I had pointed out earlier[10], it is just not the *SCI* data which points to a decline in (or stagnation of) India's share of the world's publication output; even in chemistry, which accounts for more than a sixth of India's research, India's share (of the world's publications) as seen from papers indexed in *Chemical Abstracts* has declined[11] from 3.3% in 1982 to 2.4% in 2002. In contrast, China's share of papers in *Chemical Abstracts* rose from 1.8% to 10.5% during the same period[11]. A quick check of *MathSci* database of the American Mathematical Society revealed that the number of papers from India had actually declined from 1617 (2.77% share

Table 2. Per cent share of world's publications as seen from *Web of Science* for selected countries*

		India		Brazil		S. Korea		P R China		Hong Kong	
Year	World	Papers	%	Papers	%	Papers	%	Papers	%	Papers	%
2003	1111371	23138	2.08	17012	1.53	22961	2.07	49786	4.48	7706	0.69
2002	974831	20405	2.09	14998	1.54	18420	1.89	40747	4.18	6284	0.64
2001	999749	19339	1.93	12806	1.28	17342	1.73	35392	3.54	6442	0.64
2000	956533	17500	1.83	12316	1.29	14625	1.53	30504	3.19	5607	0.59
1999	974252	18722	1.92	11678	1.20	13443	1.38	24550	2.52	5162	0.53
1998	960258	17735	1.85	10185	1.06	11920	1.24	19965	2.08	4689	0.49
1997	927786	16269	1.75	8530	0.92	9573	1.03	17008	1.83	3890	0.42
1996	904198	16486	1.82	7258	0.80	7919	0.88	14656	1.62	3190	0.35
1995	855262	16373	1.91	6526	0.76	6211	0.73	13068	1.53	2428	0.28
1994	798221	15652	1.96	5253	0.66	4161	0.52	10133	1.27	1813	0.23
1993	754305	15340	2.03	4827	0.64	3239	0.43	9595	1.27	1597	0.21

**Web of Science* searched on 21 January 2004. Figures for 2003 may go up. Hong Kong merged with China in *SCI*–CD since 2000, and in *WoS* since 1998–99. (Numbers of publication are obtained by merely giving one publication year at a time and therefore they may not be equal to the number published in the year given. However, that would not affect the conclusions drawn.)

of the world's publications) in 1991 to 1527 (2.28%) in 2001 (Arunachalam *et al*., to be published).

Such controversies – pertaining to growth and decline in publication counts – are not new. Years ago, when Margaret Thatcher was the Prime Minister, there was a debate on the decline of British science. The fixed journal set used by John Irvine, Ben Martin and colleagues[12] pointed to a decline, while the dynamic one (DIALOG-version which one would now call the CD-ROM version) used by Loet Leydesdorff[13] pointed to the UK's publication output remaining steady or even rising slightly. Anderson *et al*.[14] and Braun *et al*.[15], among others, joined the debate, which went on till *Scientometrics* published a special issue on measuring UK science in 1991. Leydersdorff's position (private commun. dated 28 January 2004) was eventually that the stability of UK science depended very much on the years one included in the time series!

Satyanarayana and Jain[1] refer to the European factor as an 'innovative alternative' to the *JCR* impact factor. Unfortunately, it is restricted to about 520 European biomedical journals ('to judge European journals under European conditions for European researchers', says the Vicer website, www.vicer.org/ VICER-EUROFACTOR.pdf) and is not widely used. As far as I know, the European factor has yet to gain wide acceptance among researchers – even in Europe.

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Cautious use of *Bt* genes in transgenic crops

Insecticidal proteins of *Bacillus thuringiensis* (*Bt*) have emerged as the proteins of choice to be expressed in transgenic crops towards an environment-friendly mode of insect pest management in agriculture[1]. Although *Bt* has been under extensive use as a biopesticide over the past five decades, its efficacy and potential have been realized only recently, because of its effective deployment in transgenic crops. Currently, two transgenic crops, viz. cotton and corn are being cultivated in more than a dozen countries[2]. These crops express different *Bt* toxins (Table 1).

Efforts are being made in many laboratories in India to develop insect pest-resistant transgenic crops[3]. However, consideration of many issues is warranted before introduction of insecticidal protein genes in various crop species. In this context, the experience/ knowledge gained in many aspects *vis-à-vis Bt*-cotton cultivation is valuable to evaluate different issues.

Transgenic cotton (Bollgard) expressing *Bt-crylAc* gene is under commercial cultivation since 2002 in India. Bt-Cry1Ac toxin confers protection to cotton which is heavily infested by four lepidopteran pests, viz. cotton bollworm (*Helicoverpa armigera*), pink bollworm (*Pectinophora gossypiella*), spotted bollworm (*Earias*

Table 1. Commercial *Bt* crops and genes expressed by them

Crop	Gene	Target pest
Commercial		
Cotton	*crylAc*	Bollworm
	cry2Ab	Bollworm
Corn	*cry1Ab*	European corn borer
	cry1Ac	European corn borer
	cry9C (discontinued)	European corn borer
	cry3Bb	Corn rootworm
	cry1F	European corn borer, southwestern corn borer, fall armyworm and black cutworm
Potato	*cry3Aa* (discontinued)	Colorado potato beetle
To become commercial soon		
Cotton	*cry1Ac + cry2Ab*	Bollworm
	cry1Ac + cry1F	Bollworm and fall armyworm
	Vip3A	Bollworm and fall armyworm
Corn	*cry34Ab/35Ab*	Corn rootworm

Source: http://www.isb.vt.edu/