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A citation analysis of Austrian medical research and Wiener klinische Wochenschrift *

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Eine Zitieranalyse der österreichischen medizinischen Forschung und der Wiener klinischen Wochenschrift

Es werden die Kriterien zur Verleihung des Nobelpreises, welche auf der Zitierungshaufigkeit und bereits verliehener Preise basieren, prasentiert. Die Stellung der medizinischen Forschung in Österreich und die Rolle der „Wiener klinischen Wochenschrift“ werden mit dem internationalen Standard verglichen.

Schlüsselwörter: Zitieranalyse, medizinische Forschung in Österreich, wissenschaftliche Produktivitat.

Summary. Criteria for the prediction of Nobel price winners based on citation and predictor prizes are presented. The position of Austrian medical research and the role of the “Wiener klinische Wochenschrift” are compared to international standards.

Key *words:* Citation analysis, Austrian medical research, scientific productivity.

Introduction

In a few weeks, an annual, worldwide contest for the very highest honor in scientific research will be resolved with the announcement of the Nobel prizes. Trying to predict who will win this championship of science has long been a parlor game for scientists everywhere.

The fact is that no one – except perhaps members of the Nobel award committee- can possibly predict the fields or discoveries that will be selected, much less the actual winners. However, I will try to show you that, like the weather, winners of the Nobel prize can be intelligently forecast. And I hope that this discussion will serve as an introduction to and demonstration of some of the techniques and principles which I will use to analyze Austrian medical science, and the medical journal “Wiener klinische Wochenschrift”.

I do not know whether among you there are readers of “The Scientist”, the biweekly trade newspaper of the science profession, of which I am publisher and editor-in-chief. If you do read “The Scientist”, you may recall an article it carried almost exactly one year ago. The article contained a list of 20 researchers who, it said, were “of Nobel class” and most likely to win the Nobel prize in physiology or medi cine. Two weeks later, two of those 20 scientists were named by the Nobel committee as winners of the 1989 prize. As you will recall, they were J. Michael Bishop and Harold E. Varmus, both of the University of California, San Francisco. The secret of “The Scientis’s” success was not inside information, expert informants, or even dumb luck. It was merely the application of two fairly simple criteria.

Citation frequency

The first criteria of Nobel-class science is citation frequency. In fact, the overwhelming majority of Nobelists, like all highly creative people, are productive. They publish five times more, and are cited 30 to 50 times more often than the average scientist. Predictably, both Bishop and Varmus were citation superstars. Bishop’s work was cited over 10,000 times, making him the 24th most-cited scientist in the database for 1973-1984. And Varmus was cited over 8,700 times, making him the 55th most-cited.

The database from which these citation rankings are derived is the Science Citation Index, published by the Institute for Scientific Information (ISI), in Philadelphia. Over the past 50 years, almost 7 million unique names have appeared as bylines on ISI-indexed articles.

During the past decade or more only about a million of these have ever been cited and the top one percent of cited authors includes about 10,000 names. To be listed in the top 0.2 percentile – the threshold for inclusion on the list of Nobel prize candidates – ranks a scientist in the top 2,000 worldwide, regardless of discipline.

To give you just one more indication of the high correlation between citation ranking and Nobel stature, in 1968 we compiled a list of the 50 most-cited scientist in the 1967 Science Citation Index. The list included six scientists who had already won the Nobel prize, and six more who were awarded the prize in later years.

Predictor prizes

The second criteria is that most Nobel prize winners have previously been honored with other prestigious awards- such as the Lasker, Wolf, Gairdner, or Priestly or has gained membership in a national academy. In fact, at the time Bishop and Varmus won the Nobel

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prize they had already won two "predictor prizes", the Lasker in 1982 and the Gairdner in 1984.

Hence to formulate its list of 20 scientists of "Nobel class", The Scientist (David Pendlebury, Editor of Science Watch) used these straightforward selection criteria: exceedingly high citation counts, and receipt of Nobel precursor prizes. We knew that most of those likely to become future Nobel laureates would have both. But still, it was a surprise how quickly our forecast came true!

This year, in a three-part series of articles which concluded just a few days ago, "The Scientist" has selected 37 contenders for the 1990 Nobel prize in three categories: physics, chemistry, and medicine or physiology. Each of the 37 scientists selected are highly cited, and most have won a number of "predictor" prizes.

1. *"The Scientist" 1990 Nobel prize forecast: Physics*

Here are our selections for the Nobel prize in physics. Just to note a few, Marvin L. Cohen of the University of California, Berkeley, who is known for his work on semiconductors, ranks among the top 0.02 percent of 1.3 million cited scientists for 1981-1988. Allen J. Heeger of the University of California, Santa Barbara, specializes in synthetic materials and superconductivity, and has received over 8,000 citations to his work during the period 1973-1984.

2. *"The Scientist" 1990 Nobel prize forecast: Chemistry*

For the Nobel prize in chemistry, "The Scientist" picked the following names: Donald M. Jerina of the National Institutes of Health, an organic chemist and biochemist who has authored more than 60 scientific papers that have been cited more than 50 times each; Frank A. Cotton, of Texas A & M University who has done breakthrough work on molecular structure and bonding, ranked among the top 0.2 percent of cited researchers during the 1980s, and has contributed to more than 140 highly cited articles; and Elias J. Corey of Harvard University has accumulated well over 5,000 citations for his papers on chemical synthesis during the 1980s.

3. *"The Scientist"* 1990 *Nobel prize forecast: Medicine* or *physiology*

Topping the list of candidates for the medicine or physiology Nobel prize is Pierre Chambon of the Institute of Biological Chemistry in Strasbourg, France and Sydney Brenner of the Medical Research Council Laboratory of Molecular Biology in Cambridge, U.K. These two molecular biologists have each produced more than 50 papers cited more than 50 times each, and their work together has furthered the understanding of human genetic disease. The list contains some very well known names, including that of Robert C. Gallo of the National Institutes of Health and Luc Montagnier of the Pasteur Institute, credited with identifying the retrovirus that causes AIDS. Gallo was the most cited researcher of the 1980s.

I regret that I cannot say that any of the Nobel candidates we've selected are from Austria. And in fact, few are European: on the physics list only John Ellis and D. V. Nanopoulos of the European Organization for Nuclear Research, Geneva, and Michael B. Green of Queen Mary College, London. In chemistry, all of our candidates are Americans. In medicine or physiology, however, there are five European candidates: Pierre Cambon and Luc Montagnier of France; and Sydney Brenner, Michael Berridge, and Hans W. Kosterlitz of the U.K.

We'll know in a few weeks whether we can again claim to have correctly forecast any winners. Buth whether or not any of the 37 scientists we selected actually win the Nobel prize, I can state with confidence that each is certainly "of Nobel class".

Austrian research

Looking at scientific productivity on the basis of the number of articles, Austria ranges among other European countries of similar size, however, the number of cited articles and the percentage is markedly lower (Table 1). Ranking the nations by the 5 year impact gives a completely different picture (Table 2), Switzerland topping the list, while U.S.A., U.K., and Germany leading the list of

Table 1. 1984 *ISI Articles: top 25 nations by productivity*

COUNTRY	1964 ARTICLES	% ISI	1984-I 988 CITATIONS	% ISI	CITED ARTICLES	% ISI	5-Y EAR IMPACT	CITED IMPACT	% CITED
USA	303,613	42.0	1,495,949	51.7	161,126	42.0	4.93	9.28	53.1
UK	67,439	9.3	279,260	9.6	36,295	9.5	4.14	7.69	53.8
FRG	41,147	5.7	160,682	5.6	22,240	5.8	3.91	7.22	54.1
USSR	40,295	5.6	43,325	1.5	14,327	3.7	1.07	3.02	35.6
Japan	39,840	5.5	162,842	5.6	25,343	6.6	4.09	6.43	63.6
Canada	32,181	4.5	120,950	4.2	17,775	4.6	3.76	6.80	55.2
France	31,621	4.4	119,516	4.1	17,184	4.5	3.78	6.96	54.3
Italy	15,421	2.1	48,089	1.7	8,740	2.3	3.12	5.50	56.7
Australia	15,058	2.1	57,643	2.0	8,873	2.3	3.83	6.50	58.9
India	14,346	2.0	19,586	.7	6,755	1.8	1.37	2.90	47.1
Netherlands	11,136	1.5	57,145	2.0	7,162	1.9	5.13	7.98	64.3
Sweden	9,662	1.3	56,090	1.9	6,660	1.7	5.81	8.42	68.9
Switzerland	8,316	1.2	48,941	1.7	4,760	1.2	5.89	10.28	57.2
GDR	7,055	1 .0	10,520	.4	3,000	.8	1.49	3.51	42.5
Israel	6,734	.9	26,704	.9	4,109	1.1	3.97	6.50	61.0
Spain	6,231	.9	15,026	.5	3,094	.8	2.41	4.86	49.7
Belgium	6,002	.8	22,896	.8	3,370	.9	3.81	6.79	56.2
Poland	5,238	.7	10,178	.4	2,886	.8	1.94	3.53	55.1
Czechoslovakia	4,878	.7	7.656	.3	2,289	.6	1.57	3.35	46.9
Denmark	4,741	.7	23,378	.8	3,101	.8	4.93	7.54	65.4
Austria	4,026	.6	9,391	.3	1,887	.5	2.33	4.98	46.9
Finland	3 933	.5	15 505	.5	2,480	6	394	625	631
Hungary	3,738	.5	6,920	.2	1,568	.4	1.85	4.41	41.9
South Africa	3,434	.5	7,717	.3	1,837	.5	2.25	4.20	53.5
Norway	3,233	.4	12,221	.4	1,989		3.78	6.14	61.5
141 Other Countries	32,977	4.6	58,758	2.0	15,166	3.9	1.78	3.87	46.0
Total Addressed	722,295	100.0	2,896,888	100.0	384,016	100.0	4.01	7.54	53.2
Unaddressed	174,450		21,370		9,595		0.12	2.23	5.5
TOTAL ISI	896,740		2,918,258		393,611		3.25	7.41	43.89

Table 2. 1984 *ISI articles: top* 25 *nations by 5-year impact*

LANGUAGE	1984 ITEMS	% ISI	1984-I 988 CITATIONS	% ISI	CITED ITEMS	5-YEAR IMPACT	CITED IMPACT
English	759,753	84.7	2,841,591	97.4	362,602	3.74	7.84
German	43,533	4.9	27,745	1.0	9,989	.64	2.78
French	35,050	3.9	17,081	.6	6,707	.49	2.55
Russian	30,578	3.4	26,284	.9	11,238	.86	2.34
Spanish	7,161	.8	945	—	549	.13	1.72
Japanese	5,743	.6	2,809	.1	1,354	.49	2.07
Italian	5,626	.6	201	—	156	.04	1.29
Czech.	1,847	.2	449	—	295	.24	1.52
Dutch	1,206	.1	100	—	52	.08	1.92
Portug.	1,096	.1	176	—	125	.16	1.41
Swedish	780	.1	12	—	10	.02	1.20
Polish	710	.1	163	—	114	.23	1.43
Hungarian	686	.1	178	—	102	.26	1.75
Chinese	682	.1	219	—	131	.32	1.67
Ukranian	622	.1	169	—	100	.27	1.69
16 Other Languages	5,147	.6	877	—	544	.17	1.61
Total	896,740	100.0	2,918,258	100.0	393,611	3.25	7.41

Table 3. 1984 *ISI articles: language distribution*

COUNTRY	1984 ARTICLES	1984-I 988 CITATIONS	CITED ARTICLES	5-YEAR IMPACT	CITED IMPACT	% CITED
Switzerland	8,316	48,941	4,760	5.89	10.28	57.2
Sweden	9,662	56,090	6,660	5.81	8.42	68.9
Netherlands	11,136	57,145	7,162	5.13	7.98	64.3
USA	303,613	1,495,949	161,126	4.93	9.28	53.1
Denmark	4,741	23,378	3,101	4.93	7.54	65.4
UK	67,439	279,260	36,295	4.14	7.69	53.8
Japan	39,840	162,842	25,343	4.09	6.43	63.6
Israel	6,734	26,704	4,109	3.97	6.50	61.0
Finland	3,933	15,505	2,480	3.94	6.25	63.1
FRG	41,147	160,682	22,240	3.91	7.22	54.1
Australia	15,058	57,643	8,873	3.83	6.50	58.9
Belgium	6,002	22,896	3,370	3.81	6.79	56.2
France	31,621	119,516	17,184	3.78	6.96	54.3
Norway	3,233	12,221	1,989	3.78	6.14	61.5
Canada	32,181	120,950	17,775	3.76	6.80	55.2
New Zealand	3,174	9,902	1,832	3.12	5.41	57.7
Italy	15,421	48,089	8,740	3.12	5.50	56.7
Spain	6,231	15,026	3,094	2.41	4.86	49.7
Austria	4,026	9,391	1,887	2.33	4.98	46.9
Greece	1,290	2,954	731	2.29	4.04	56.7
South Africa	3,434	7,717	1,837	2.25	4.20	53.5
Ireland	1,626	3,496	720	2.15	4.86	44.3
Argentina	1,922	3,393	937	2.08	4.26	48.7
Poland	5,238	10,178	2,886	1.94	3.53	55.1
Hungary	3,738	6,920	1,586	1.85	4.41	41.9
TOTAL ISI	896,740	2,918,258	393,611	3.25	7.41	43.9

Table 4. *Medicine: national comparisons by productivity*

COUNTRY	1984 ARTICLES	1984-I 988 CITATIONS	CITED ARTICLES	5-YEAR IMPACT	CITED IMPACT	% CITED
USA	101,299	631,913	64,407	6.24	9.81	63.58
SCANDINAVIA	12,727	62,543	8,382	4.91	7.48	65.70
Sweden	5,732	32,152	3,960	5.61	8.12	69.09
Denmark	2,963	13,654	1,930	4.61	7.07	65.14
Norway	1,653	6,954	998	4.21	6.97	60.38
Finland	2,350	9,753	1,483	4.15	6.58	63.11
Iceland	29	30	8	1.03	3.75	27.59
UK	26,995	127,519	16,212	4.72	7.87	60.06
England	22,232	108,665	13,475	4.89	8.06	60.61
Scotland	3,297	14,222	1,948	4.31	7.30	59.08
Wales	870	3,481	528	4.00	6.59	60.69
North Ireland	596	1,151	261	1.93	4.41	43.79
WEST EUROPE	54,418	175,805	26,659	3.23	6.59	48.99
Netherlands	4,978	26,191	3,166	5.26	8.27	63.60
Switzerland	3,611	18,261	2,033	5.06	8.98	56.30
Belgium	2,490	10,806	1,425	4.34	7.58	57.23
Fed. Rep. Ger.	16,024	47,895	7,583	2.99	6.32	47.32
France	14,167	41,117	6,450	2.90	6.37	45.53
Italy	7,218	19,746	3,677	2.74	5.37	50.94
Portugal	159	395	80	2.48	4.94	50.31
AUSTRIA	2,002	4,597	881	2.30	5.22	44.01
Ireland	745	1,638	297	2.20	5.52	39.87
Greece	352	742	181	2.11	4.10	51.42
Spain	2,673	4,459	887	1.67	5.03	33.18

Table 5. *Medicine: national comparisons by impact*

COUNTRY	1984 ARTICLES	1984-1988 CITATIONS	CITED ARTICLES	5-YEAR IMPACT	CITED IMPACT	% CITED
USA	101,299	631,913	64,407	6.24	9.81	63.58
WEST EUROPE	54,418	175,805	26,659	3.23	6.59	48.99
Fed. Rep. Ger.	16,024	47,895	7,583	2.99	6.32	47.32
France	14,167	41,117	6,450	2.90	6.37	45.53
Italy	7,218	19,746	3,677	2.74	5.37	50.94
Netherlands	4,978	26,191	3,166	5.26	8.27	63.60
Switzerland	3,611	18,261	2,033	5.06	8.98	56.30
Spain	2,673	4,459	887	1.67	5.03	33.18
Belgium	2,490	10,806	1,425	4.34	7.58	57.23
AUSTRIA	2,002	4,597	881	2.30	5.22	44.01
Ireland	745	1,638	297	2.20	5.52	39.87
Greece	352	742	181	2.11	4.10	51.42
Portugal	159	395	80	2.48	4.94	50.31
UK	26,995	127,519	16,212	4.72	7.87	60.06
England	22,232	108,665	13,475	4.89	8.06	60.61
Scotland	3,297	14,222	1,948	4.31	7.30	59.08
Wales	870	3,481	528	4.00	6.59	60.69
North Ireland	596	1,151	261	1.93	4.41	43.79
SCANDINAVIA	12,727	62,543	8,382	4.91	7.48	65.70
Sweden	5,732	32,152	3,960	5.61	8.12	69.09
Denmark	2,963	13,654	1,930	4.61	7.07	65.14
Finland	2,350	9,753	1,483	4.15	6.58	63.11
Norway	1,653	6,954	998	4.21	6.97	60.38
Iceland	29	30	8	1.03	3.75	27.59

Table 6. 1984 *Austrian articles: distribution by field*

FIELD	1984 ARTICLES	1984-I 988 CITATIONS	CITED ARTICLES	5-Y EAR IMPACT	CITED IMPACT	% CITED
Multidisc.	15	153	13	10.20	11.77	86.7
Chemistry	285	1,155	214	4.05	5.40	75.1
Physics	357	1,295	252	3.63	5.14	70.6
Life Sci.	562	1,319	256	2.35	5.15	45.5
Medicine	2,002	4,597	881	2.30	5.22	44.0
Technology	51	101	29	1.98	3.48	56.9
Engineering	217	412	101	1.90	4.08	46.5
Geosciences	42	72	28	1.71	2.57	66.7
Mathematics	125	162	67	1.30	2.42	53.6
Total SCI	3,656	9,266	1,841	2.53	5.03	50.4
Total SSCI	205	121	42	0.59	2.88	20.5
Total A&HCI	165	4	4	0.02	1.00	2.4
TOTAL ISI	4,026	9,391	1,887	2.33	4.98	46.9

Table 7. *1984 Austrian articles: impact rank*

FIELD	1984 ARTICLES	1984-I 988 CITATIONS	CITED ARTICLES	5-YEAR IMPACT	CITED IMPACT	% CITED
Medicine	2,002	4,597	881	2.30	5.22	44.0
Life Sci.	562	1,319	256	2.35	5.15	45.5
Physics	357	1,295	252	3.63	5.14	70.6
Chemistry	285	1,155	214	4.05	5.40	75.1
Engineering	217	412	101	1.90	4.08	46.5
Mathematics	125	162	67	1.30	2.42	53.6
Technology	51	101	29	1.98	3.48	56.9
Geosciences	42	72	28	1.71	2.57	66.7
Multidisc.	15	153	13	10.20	11.77	86.7
Total SCI	3,656	9,266	1,841	2.53	5.03	50.4
Total SSCI	205	121	42	0.59	2.88	20.5
Total A&HCI	165	4	4	0.02	1.00	2.4
TOTAL	4,026	9,391	1,887	2.33	4.98	46.9

Table 8. *Austrian versus SCI fields: impact comparisons*

FIELD	AUSTRIA 5-Y EAR IMPACT	AUSTRIA CITED IMPACT	SCI 5-YEAR IMPACT	SCI CITED IMPACT	AUSTRIA:SCI 5-YEAR IMPACT	AUSTRIA:SCI CITED IMPACT
Multidisc.	10.20	11.77	8.55	20.43	1.19	0.58
Chemistry	4.05	5.40	4.07	6.64	1 .00	0.81
Physics	3.63	5.14	4.93	7.79	0.74	0.66
Life Sci.	2.35	5.15	4.84	8.26	0.49	0.62
Medicine	2.30	5.22	4.29	8.00	0.54	0.65
Technology	1.98	3.48	1.99	4.53	0.99	0.77
Engineering	1.90	4.08	1.08	3.91	1.76	1.04
Geosciences	1.71	2.57	3.56	6.32	0.48	0.41
Mathematics	1.30	2.42	1.46	3.27	0.89	0.74
Total SCI	2.53	5.03	4.04	7.71	0.63	0.65
Total SSCI	0.59	2.88	0.97	3.85	0.61	0.75
Total A&HCI	0.02	1 .00	0.04	2.21	0.50	0.45
TOTAL ISI	2.33	4.98	3.25	7.41	0.72	0.67

productivity are found in positions 4, 6, and 10 only. The language distribution clearly shows the predominant role of English as the scientific language of the world. If an article is written in German (Table 3) the citation frequency is much lower, meaning that an article written in German language clearly is cited less frequently. A national comparison of productivity (Table 4) again indicates a comparable number of articles to nations we are usually comparing us with, however, citation again being lower (Table 5). The predominant number of Austrian scientific articles deal with medicine, however, the citation frequency is far below that for other topics, such as physics, chemistry, biosciences etc. (Table 6). This is nicely reflected by the impact rank where medicine has only the 5th position (Table 7). Comparing Austrian with international research this achieves only half the international citation impact while Austrian engineering for example even exceeds the international level and chemistry ranges far above medicine (Table 8). The specialties ranking by productivity (Table 9) shows a very wide distribution, pharmacology reaching the highest citation. Ranking by 5-year impact shows a leading position for genetics, physiology and pharmacology (Table 10) while others achieving higher citation are represented by a few articles only in the observation period. An impact comparison of Austrian versus international medicine demonstrates that only pharmacology and orthopedics exceed the international mean value (Table 11).

Journals and the “Wiener klinische Wochenschrift”

A list of the top 20 medical journals according to 5 year impact contains no journal appearing in German language (Table 12). Ranking of German language medical journals by 5 year impact shows the “Wiener klinische Wochenschrift” at position 28 (Table 13). It ranges behind comparable journals such as “Deutsche Medizinische Wochenschrift” und “Schweizer Medizinische Wochenschrift” but in front of “Münchner Medizinische Wochenschrift”. They also show that it is by far the leading Austrian medical scientific journal. Looking at the 5-year impact factors (Table 14) the “Wiener klinische Wochenschrift” keeps position 27 with its impact factors being stable throughout the last 5 years while most of the other journals (n = 15) exhibited a decrease indicating a relative

Table 9. *Austrian medicine: specialties ranked by productivity (cont.)*

SPECIALTY	1984 ARTICLES	1984-I988 CITATIONS	CITED ARTICLES	5-YEAR IMPACT	CITED IMPACT	% CITED
General/Internal Med.	549	540	140	0.98	3.86	25.50
Surgery	138	160	58	1.16	2.76	42.03
Neurosciences	114	433	60	3.80	7.22	52.63
Pharmacology	94	525	70	5.59	7.50	74.47
Hematology	79	118	19	1.49	6.21	24.05
Dermatology/Vener. Dis.	78	174	41	2.23	4.24	52.56
Radiology/Nucl. Med.	78	128	40	1.64	3.20	51.28
Immunology	71	471	32	6.63	14.72	45.07
Obstetrics/Gynecology	69	141	41	2.04	3.44	59.42
Oncology	68	335	44	4.93	7.61	64.71
Cardiovascular	67	227	47	3.39	4.83	70.15
Pediatrics	55	50	19	0.91	2.63	34.55
Ophthalmology	55	49	19	0.89	2.58	34.55
Urology/Nephrology	54	68	21	1.26	3.24	38.89
Endocrinology	49	161	27	3.29	5.96	55.10
Rheumatology	31	40	11	1.29	3.64	35.48
Cytology/Histology	30	111	20	3.70	5.55	66.67
Anesthesiology	27	25	13	0.93	1.92	48.15
Pathology	27	63	19	2.33	3.32	70.37
Otorhinolaryngology	27	29	10	1.07	2.90	37.04
Microbiology	27	147	17	5.44	8.65	62.96
Gastroenterology	27	84	16	3.11	5.25	59.26
Med. Research/Exper.	22	64	13	2.91	4.92	59.09
Physiology	21	132	16	6.29	8.25	76.19
Orthopedics	21	21	3	1 .00	7.00	14.29
Respiratory	21	36	7	1.71	5.14	33.33
Genetics/Heredity	17	87	14	5.12	6.21	82.35
Psychiatry	17	32	8	1.88	4.00	47.06
Anatomy/Morphology	17	21	7	1.24	3.00	41.18
Misc. Medicine	16	26	5	1.62	5.20	31.25
Public Health	13	32	9	2.46	3.56	69.23
Geriatrics/Gerontology	9	14	6	1.56	2.33	66.67
Virology	5	46	4	9.20	11.50	80.00
Dentistry/Odontology	4	2	2	0.50	1 .00	50.00
Allergy	1	2	1	2.00	2.00	100.00
Parasitology	1	1	1	1 .00	1 .00	100.00
Developmental Biology	1	2	1	2.00	2.00	100.00
Tropical Medicine	1	0	0	—	—	—
Toxicology	1	0	0	—	—	—
TOTAL MEDICINE	2,002	4,597	881	2.30	5.22	44.01
Biochem./Molec. Biol.	212	741	82	3.50	9.04	36.68

Table 10. *Austrian medicine: specialties ranked by 5-year impact (cont.)*

SPECIALTY	1984 ARTICLES	1984-1988 CITATIONS	CITED ARTICLES	5-YEAR IMPACT	CITED IMPACT	% CITED
Virology	5	46	4	9.20	11.50	80.00
Immunology	71	471	32	6.63	14.72	45.07
Physiology	21	132	16	6.29	8.25	76.19
Pharmacology	94	525	70	5.59	7.50	74.47
Microbiology	27	147	17	5.44	8.65	62.96
Genetics/Heredity	17	87	14	5.12	6.21	82.35
Oncology	68	335	44	4.93	7.61	64.71
Neurosciences	114	433	60	3.80	7.22	52.63
Cytology/Histology	30	111	20	3.70	5.55	66.67
Cardiovascular	67	227	47	3.39	4.83	70.15
Endocrinology	49	161	27	3.29	5.96	55.10
Gastroenterology	27	84	16	3.11	5.25	59.26
Med. Research/Exper.	22	64	13	2.91	4.92	59.09
Public Health	13	32	9	2.46	3.56	69.23
Pathology	27	63	19	2.33	3.32	70.37
Dermatology/Vener. Dis.	78	174	41	2.23	4.24	52.56
Obstetrics/Gynecololgy	69	141	41	2.04	3.44	59.42
Developmental Biology	1	2		2.00	2.00	100.00
Allergy	1	2		2.00	2.00	100.00
Psychiatry	17	32	8	1.88	4.00	47.06
Respiratory	21	36	7	1.71	5.14	33.33
Radiology/Nucl. Med.	78	128	40	1.64	3.20	51.28
Misc. Medicine	16	26	5	1.62	5.20	31.25
Geriatrics/Gerontology	9	14	6	1.56	2.33	66.67
Hematology	79	118	19	1.49	6.21	24.05
Rheumatology	31	40	11	1.29	3.64	35.48
Urology/Nephrology	54	68	21	1.26	3.24	38.89
Anatomy/Morphology	17	21	7	1.24	3.00	41.18
Surgery	138	160	58	1.16	2.76	42.03
Otorhinolaryngology	27	29	10	1.07	2.90	37.04
Parasitology	1	1	1	1 .00	1 .00	108.00
Orthopedics	21	21	3	1 .00	7.00	14.29
Internal/General Med.	549	540	140	0.98	3.86	25.50
Anesthesiology	27	25	13	0.93	1.92	48.15
Pediatrics	55	50	19	0.91	2.63	34.55
Ophthalmology	55	49	19	0.89	2.58	34.55
Dentistry/Odontology	4	2	2	0.50	1 .00	50.00
Tropical Medicine	1	0	0	—	—	—
Toxicology	1	0	0	—	—	—
TOTAL MEDICINE	2,002	4,597	881	2.30	5.22	44.01
Biochem./Molec. Biol.	212	741	82	3.50		38.68

Table 11. *Austrian versus SCI medicine: impact comparisons*

	Austria 5-year impact	Cited impact	SC1 5-year impact	Cited impact	Austria : 5-year impact	Cited impact
Virology	9.20	11.50	10.08	11.71	0.91	0.98
Immunology	6.63	14.72	10.52	15.10	0.63	0.97
Pharmacology	5.50	7.50	4.38	6.91	1.28	1.09
Microbiology	5.44	8.05	6.61	9.15	0.82	0.95
Genetics/Heredity	5.12	6.21	6.40	9.47	0.80	0.66
Oncology	4.98	7.61	7.75	10.03	0.64	0.76
Neurosciences	3.80	7.22	6.52	9.91	0.58	0.73
Cytology/Histology	3.70	5.55	5.74	9.28	0.64	0.60
Cardiovascular	3.30	4.88	4.94	8.78	0.70	0.55
Endocrinology	3.20	5.96	6.67	9.73	0.49	0.61
Gastroenterology	3.11	5.25	3.40	6.62	0.89	0.79
Med. Research/Exper.	2.91	4.92	2.76	7.42	1.05	0.66
Public Health	2.46	3.56	2.79	5.50	0.88	0.64
Pathology	2.38	3.32	3.92	7.16	0.59	0.46
Dermatology/Vener. Dis.	2.23	4.24	2.73	4.87	0.82	0.87
Obstetrics/Gynecology	2.04	3.44	4.12	6.34	0.50	0.54
Developmental Biology	2.00	2.00	2.14	5.55	0.98	0.36
Allergy	2.00	2.00	4.80	7.19	0.42	0.28
Psychiatry	1.88	4.00	3.86	7.94	0.40	0.50
Respiratory	1.71	5.14	5.15	8.31	0.38	0.62
Radiology/Nucl. Med.	1.64	3.20	3.35	6.48	0.49	0.49
Misc. Medicine	1.62	5.20	1.11	3.00	1.46	1.44
Geriatrics/Gerontology	1.56	2.33	1.06	4.70	0.94	0.50
Hematology	1.49	6.21	4.80	9.07	0.31	0.68
Rheumatology	1.29	3.64	3.86	6.74	0.33	0.54
	1.26	3.24	2.48	5.57	0.51	0.53
Anatomy/Morphology	1.24	3.00	2.06	4.89	0.60	0.61
Surgery	1.16	2.76	2.81	5.65	0.41	0.40
Otorhinolaryngology	1.07	2.90	1.63	3.55	0.86	0.82
Parasitology	1.00	1.00	3.77	5.54	0.27	0.18
Orthopedics	1.00	7.80	0.96	3.32	1.04	2.11
General/Internal Med.	0.88	3.86	2.90	7.88	0.34	0.49
Anesthesiology	0.93	1.92	3.15	5.55	0.30	0.35
Pediatrics	0.91	2.63	2.78	5.90	0.33	0.45
Ophthalmology	0.89	2.53	3.03	5.55	0.29	0.46
Dentistry/Odontology	0.50	1.00	1.43	3.98	0.35	0.25
Total Medicine	2.30	5.22	4.29	8.00	0.54	0.65
Biochem./Molec. Biol.	3.50	9.04	12.19	15.12	0.29	0.60

improvement in the position of the journals written in German language (Table 15). Examining the number of foreign scientists publishing in Austria, this number appears to be very small with contributions being from German only. Similarly, the foreign citations of the "Wiener klinische Wochenschrift" are predominantly by Germans (Table 16). Looking at articles cited at least 50 times before the second world war, there is still a predominant position of papers which appeared around the beginning of this century, the nobel class work of Landsteiner still appearing at position 4 (Table 17). The Austrian citation classics are very small in number and all come from pharmacologists such as W. Birkmayer, 0. Hornykiewicz, W. Kobinger, C. H. Stumpf and H. Winkler. The 1988 research front shows that in some areas there is quite a remarkable contribution of Austrian medical science to international literature (Table 18) as in urinary neopterin excretion, low dose aspirin in peripheral arterial occlusive disease, and the clinical application of prostaglandins.

Conclusion

I believe I've painted an objective picture of Austrian medical science, as reflected by the worldwide published literature. Now let me turn to the question of what can be done to increase the impact of Austrian medical science, or, put another way, what can be done to convince physicians and biomedical researchers worldwide to cite Austrian journals and Austrian scientists.

Various studies have shown that English predominates as the worldwide language of science, and that the United States and the United Kingdom dominate medical publishing. While nearly every significant medical journal is covered on the Science Citation Index, the selection

Table 12. *Top* 20 *medical journals: 5-year impact*

Journal	1984 Articles	1984-1988 Citations	Cited Articles	5-Year Impact	Cited Impact
J.Exper.Med.	294	12,989	290	44.18	44.79
J. Clin. Invest.	487	15,130	480	31.07	31.52
Arch. Gen. Psychiat.	197	5,364	163	27.23	32.91
J. Neurosci.	293	7,815	291	26.67	26.86
Circulation Res.	172	4,375	162	25.44	27.01
J. Immunology	1,076	26,176	1,049	24.33	24.95
Blood	444	9,156	415	20.62	22.06
Eur. J. Immunology	211	4,074	207	19.31	19.68
Neuroscience	272	5,227	265	19.22	19.72
Gene	247	4,586	238	18.57	19.27
J. Clin. Endocr. Metab.	420	7,743	415	18.44	18.66
J. Compar. Neurology	377	6,939	364	18.41	19.06
J. Virology	563	9,976	550	17.72	18.14
J. Neurophysiology	165	2,781	164	16.85	16.96
Diabetes	204	3,420	204	16.76	16.76
Cancer Research	990	16,524	956	16.69	17.28
Developmental Biology	323	5,257	319	16.28	16.48
Amer. J. Pathology	212	3,447	208	16.26	16.57
Endocrinology	720	11,335	707	15.74	16.03
J. Pharm. Exper. Ther.	479	7,393	465	15.43	15.90

Table 14. *German-language medical journals: 5-year impact factors*

Journal	1989	1988	1987	1986	1985
Klinische Wochen.	0.95	1.21	0.99	1.23	1.30
Deutsche Med. Wochen.	0.86	0.93	1.01	0.95	1.29
Z. Kardiologie	0.83	0.70	0.67	0.77	1.72
Z. Gastroenterologie	0.66	0.78	0.68	0.65	1.11
Urologe	0.57	0.57	0.42	0.35	0.63
Arch. Pharmazie	0.52	0.62	0.45	0.56	0.56
Geburtshilfe Frauen.	0.51	0.38	0.51	0.45	0.68
Anaesthesist	0.47	0.51	0.48	0.42	0.72
F. Rontgenstr. Nukl.	0.47	0.46	0.55	0.50	0.79
Nervenarzt	0.46	0.50	0.38	0.43	0.75
Leber Magen Darm	0.41	0.30	0.35	0.20	0.47
Hautatzt	0.40	0.49	0.47	0.40	0.69
VASA	0.40	0.79	0.36	0.34	0.42
Z. Rechtsmedizin	0.42	0.36	0.27	0.27	0.25
Onkologie	0.39	0.38	0.40	0.45	0.46
Z. Rheumatologie	0.39	0.47	0.48	0.37	0.45
Internist	0.38	0.37	0.42	0.42	0.70
Pharmazie	0.38	0.41	0.49	0.45	0.46
Schweiz. Med. Wochen.	0.36	0.38	0.39	0.43	0.56
Pathologe	0.34	0.50	0.48	0.42	0.66
Klin. Monats. Augen.	0.32	0.36	0.23	0.36	0.34
F. Neurologie Psychi.	0.31	0.49	0.55	0.54	0.39
Z. Geburtshilfe Peri.	0.31	0.29	0.23	0.28	0.46
Infus. Klin. Ernahr.	0.30	0.43	0.30	0.49	0.83
Radiologe	0.28	0.25	0.32	0.38	0.53
Langen. Arch. Chirur.	0.26	0.13	0.16	0.14	0.28
Tumordiagnostik Ther.	0.25	0.30	0.22	0.33	0.57
Wiener Klin. Wochen.	0.24	0.24	0.25	0.24	0.28
Anatomischer Anz.	0.22	0.24	0.26	0.23	0.39
Medizinische Klinik	0.22	0.33	0.20	0.12	0.25
Klin. Padiatrie	0.21	0.26	0.33	0.29	0.44
Monats. Kinderheil.	0.17	0.18	0.19	0.25	0.40
Herz Kreislauf	0.15	0.21	0.16	0.33	0.33
Munchen. Med. Wochen.	0.15	0.14	0.11	0.12	0.24
Neurochirurgie	0.10	0.11	—	—	—
Z. Urologie Nephrol.	0.08	0.20	0.14	0.17	0.22
Therapeut. Umschau	0.07	0.05	0.07	0.16	0.15
Acta Med. Austriaca	0.06	0.33	0.19	0.16	0.16
Chirurg	—			0.28	0.73

Table 13. *German-language medical journals: 5-year impact*

Journal	1984 Articles	1984-I 988 Citations	Cited Articles	5-Year Impact	Cited Impact
Klinische Wochen.	253	785	161	3.10	4.88
Z. Kardiologie	115	333	90	2.90	3.70
Arch. Pharmazie	194	401	145	2.07	2.77
Tumordiagnostik	50	101	32	2.02	3.16
F. Rontgenstr. Nukl.	314	621	209	1.98	2.97
Deutsche Med. Wochen.	682	1,226	342	1.80	3.58
Pathologe	58	99	34	1.71	2.91
Onkologie	61	102	38	1.67	2.68
Urologe	80	125	45	1.56	2.78
Pharmazie	347	521	212	1.50	2.46
Z. Geburtshilfe Peri.	56	83	34	1.48	2.44
Nervenarzt	111	162	65	1.46	2.49
Radiologe	106	152	56	1.43	2.71
Geburtshilfe Frauen.	193	231	99	1.20	2.33
VASAJ. Vascular Dis.	81	96	39	1.19	2.46
Hautarzt	179	213	73	1.19	2.92
Chirurg	184	206	96	1.12	2.15
Schweiz. Med. Wochen.	448	503	199	1.12	2.53
F. Neurologie Psychi.	49	54	27	1.10	2.00
Leber Magen Darm	49	54	26	1.10	2.08
Internist	123	134	65	1.09	2.06
Z. Rechtsmedizin	85	91	44	1.07	2.07
Infus. Klin. Ernahr.	91	90	38	0.99	2.37
Klin. Monats. Augen.	516	381	149	0.74	2.56
Anatomischer Anz.	211	136	59	0.64	2.31
Anaesthesis	353	207	97	0.59	2.13
Medizinische Klinik	127	69	35	0.54	1.97
Wiener Klin. Wochen.	287	143	82	0.50	1.74
Z. Gastroenterologre	357	156	70	0.44	2.23
Klin. Padiatrie	190	83	37	0.44	2.24
Z. Urologie Nephrol.	97	37	24	0.38	1.54
Therapeut. Umschau	121	42	29	0.35	1.45
Z. Rheumatologie	259	86	36	0.33	2.39
Herz Kreislauf	138	44	30	0.32	1.47
Monats. Kinderheil.	465	149	96	0.32	1.55
Langen. Arch. Chirur.	335	99	58	0.30	1.71
Munchen. Med. Wochen.	969	259	120	0.27	2.16
Acta Med. Austriaca	212	6	6	0.03	1.00

Table 15. *Who publishes in Wien Klin Wochemchr: 1984 SCI*

AUTHOR NATION	1984 ARTICLES	1984-I 988 CITATIONS	CITED ARTICLES	5-YEAR IMPACT	CITED IMPACT	% CITED
Austria	245	124	67	0.51	1.85	35.4
FRG	19	9	7	0.47	1.29	36.8
Switzerland	7	1	1	0.14	1.00	14.3
Hungary	3	0	0	—	—	—
UK	3	1	1	0.33	1.00	33.3
GDR	2	3	2	1.50	1.50	100.0
Netherlands	2	3	2	1.50	1.50	100.0
USA	• 2	1	1	0.50	1.00	50.0
Australia		0	0	—	—	—
Denmark	1	0	0	—	—	—
Italy	1		1	1.00	1.00	100.0
Japan	1	0	0		—	—
TOTAL	287	143	82	0.50	1.74	28.6

Table 16. Who *cites* *Wien Klin Wochenschr: 1984 – 1958 SCI*

CITING NATION	1984 ARTICLES	1984-1988 CITATIONS	CITED ARTICLES	5-YEAR IMPACT	CITED IMPACT	% CITED
TOTAL	287	143	82	0.50	1.74	28.6
Austria		98	67			
FRG		13	12			
USA		8	7			
Australia		4	4			
GDR		3	3			
Netherlands		3	3			
Switzerland		3	1			
USSR		3	3			
South Africa		1	1			
Spain		1	1			
UK		1	1			
Czechoslovakia		1	1			
Sweden		1	1			
Italy		1	1			
Finland		1	1			
Canada		1	1			

Table 17. *Wiener klinische Wochenschrift articles cited at least 50 times, 1945- 1988 SCI*

Citations		Bibliographic Information
315	7	Birkmayer W, Hornykiewicz 0 (1961) Der L-3,4-Dioxyphenylalanin (DOPA)-Effekt bei der Parkinson-Akinese. *Wien Klin Wochenschr 73: 787 – 788*
178	4	Hornykiewicz 0 (1963) Die topische Lokalisation und das Verhalten von Noradrenalin und Dopamin (3-Hydroxytyramin) in der Substantia nigra des normalen und Parkinson-kranken Menschen. *Wien Klin Wochenschr 75: 309 – 3 12*
178	3	Benjamin E, Sluka E (1908) Antikiirperbildung nach experimenteller Schädigung des hämatopoetischen Systems durch Riintgenstrahlen. *Wien Klin Wochenschr 21: 3* 1 1 *– 3 13*
86	1	Landsteiner K (190 1) Über Agglutinationserscheinungen normalen menschlichen Blutes. *Wien Klin Wochenschr 14:* 1132 – 1134
79	1	Kaznelson P (19 16) Verschwinden der hamorrhagischen Diathese bei einem Falle von „essentieller Thrombopenie“ (Frank) nach Milzexstirpation. Splenogene thrombobolytische Purpura. *Wien Klin Wochenschr 16: 1451- 1454*
70	1	Bernheimer H, Birkmayer W, Hornykiewicz 0 (1966) Homovanillinsaure im Liquor cerebrospinalis: Untersuchungen beim Parkinson-Syndrom und anderen Erkrankungen des ZNS. *Wien Klin Wochenschr 78: 417-419*
57	–	Birkmayer W (198 1) Der alpha-Methyl-P-Tyrosin-Effekt bei extrapyramidalen Erkrankungen. *Wien Klin Wochenschr 8* 1: 10 – *12*
55	5	Aschner B (1908) Über einen bisher noch nicht beschriebenen Reflex vom Auge auf Kreislauf und Atmung: Verschwinden des Radialispulses bei Druck auf das Auge. *Wien Klin Wochenschr 21: 1529- 1530*
53	–	Thaler H (1964) Über Vorteil und Risiko der Leberbiopsiemethode nach Menghini. *Wien Klin Wochenschr 76: 533 – 538*
52	1	Saxl P, Heilig R (1920) Über die diuretische Wirkung von Novasurol und anderen Quecksilberinjektionen. *Wien Klin Wochenschr 33: 934- 944*
52		Kundrat H (1893) Über Lympho-Sarkomatosis. *Wien Klin Wochenschr 6: 211 – 213*

Table 18. 1988 research *fronts with a least 5.0% of citing papers from Austria*

PERCENT AUSTRIA	TOTAL ARTICLES	RF NAME
55.5	90	Urinary neopterin excretion; HIV infection; elevated serum levels of soluble interleukin-2 receptors
23.6	38	Peripheral arterial occlusive disease; intermittent claudication; low-dose aspirin; model of Ischemia
22.5	40	Stage II-B arterial occlusive disease; intermittent claudication; intravenous prostaglandin-El infusions
20.3	54	Hemolytic uremic syndrome; plasma prostacyclin; acute renal failure
15.7	76	Quantitative LP(A) lipoprotein trait; coronary heart disease in familial hypercholesterolemia; homologous Kringle domains
14.4	104	Interleukin-1 in epidermis; murine keratinocytes; MHC antigen expression; mixed skin lymphocyte reactivity; Langerhans cells
11.5	121	Cortical components of ciliates; taxonomic descriptions; fossil testate amebas in quaternary lake sediments
11.4	148	Surface array protein; extracellular products of Aeromonas salmonicida; pathogenic strains; selection for virulence; bath vaccines; insertion mutations
8.9	178	Random number generators; nonlinear functions; uniform distribution of sequences; Monte Carlo simulation
7.0	157	Cyanobacterium Anacystis nidulans; photosynthetic oxygen evolution; genetic relatedness of marine synechococcus SPP
6.7	164	Small angle x-ray scattering; block poly(hydroxy ether siloxane) copolymers; colloidal silica particle suspensions
5.3	410	HIV infection; AIDS among seropositive homosexual men
5.3	206	Expression of major histocompatability antigens; tumor necrosis factor; recombinant interferon; glioma-specific mouse cytotoxic lymphocytes-T

policy is deliberately slanted toward material most widely used and with the highest impact. These data confirm that English is the language of contemporary medical research. This is not to say that non-English journals are inferior. But most of the vernacular journals of medicine are of primary interest to local physicians and drug firms. In a 1986 study [1], I found that although German publishers produce a number of significant science journals – mainly in English only one German-language journal appeared in the top IO- “Deutsche Medizinische Wochenschrift”, which also appears in Spanish, Italian, and Japanese editions. Whether ranking journals by impact or immediacy, there are no non-English journals in the top 10.

You must decide whether you wish to increase attention to Austrian journals or to Austrian research. To improve the impact of Austrian journals they must be internationalized. Whether you are prepared to do this or whether it serves any useful purpose, I cannot say. But implicit in these ideas is the presumed desire to publish less provincial research, or at least, much more of international interest and impact. I have demonstrated that the best American research is published in international journals. Why should an Austrian scientist publish in a journal that is less likely to attract international attention?

To improve impact you could seek to participate in more international (multi)-collaborative studies. This would fit into a growing trend especially in clinical studies with epidemiological content.

There is, of course, no substitute for excellence and your own scientists and their colleagues abroad, will recognize when and if you have convinced scientists of Nobel class to publish in your own journals. Apart from purely local considerations, such a pharmaceutical advertising why should I not be encouraging you, as I do the Latin Americans, to regionalize Eastern European journals. The changes in East Europe present you with a new challenge, as it does the competition in Germany elsewhere.

Perhaps you could emulate “Angewandte Chemie”. They issue an international edition in English. This has helped to catapult them into the top ranks of chemistry, even though they have retained their title in German, they have been able to attract contributions from Nobel class scientists from both sides of the Atlantic.

Today I believe that an invitation to publish in the “Vienna Medical Journal” would evoke a different response than an invitation from “Wiener klinische Wochenschrift” .

An unified Germany not withstanding, English remains the lingua franca of science and business. Ironically, America is the loser for that because our young people, as in the U.K., are not bi- or tri-lingual while you in Europe are multilingual. Don’t give up that advantage for the sake of short-term convenience.

Returning to the most important question, does Austria produce enough basic research to justify its own journals? I do not have the data but I would be surprised if Austria spends even 1% of its Gross National Product (GNP) on basic research. In the U.S.A., we are debating whether $8 billion is enough for the U.S.A. alone. The goal is to increase that figure to $15 billion even in the face of large budget cuts. The American people support medical research, but we need support from our allies. A huge lobby is needed in congress to increase approval of grants from the present 15 to 30%. Greater collaboration between industry and academics is also needed up to meet the challenge from Japan where the percentage of GNP spent is now higher than in the U.S.A. I don’t know how your parliament functions but perhaps you need a lobby like research in America.

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Reference

1. Garfield E (1986) Which medical journals have the greatest impact‘? Ann Intern Med 105: 313- 320

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Addendum

The Nobel prize for medicine 1990 has been awarded to J. E. Murray and I. B. D. Thomas (both they were not in the top 16-list), for physics to J. Friedman, Henry Kendall, and Richard Tay (they again were not listed in the top 10) and the prize for chemistry to Elias J. Corey (who was listed as the number 3 nomine)

H. Sinzinger