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GATEKEEPING* PATTERNS IN THE PUBLICATION OF ANALYTICAL CHEMISTRY RESEARCH

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Summary—An analysis has been made of the nationalities of the members of advisory and editorial boards of analytical chemistry journals. Correlations were sought between their number and citation rates and between their number and the number of analytical papers published by scientists from the country in question. A comparison is given for the gatekeepers of organic and inorganic chemistry journals.

The invention of a mechanism for the systematic publication of scientific work may well have been the key event in the history of modern science.[1] The main channel through which this publication flows is provided by the scientific journals.

Thus Gordon[2] states: "Publication of papers in primary research journals is widely accepted as having a central role to play in the continuance of science as an intellectual and social activity. In particular it is recognised as being both a means by which researchers are able to establish and advance themselves professionally, and the medium through which contributions are made to a discipline's body of *ratified knowledge*. Consequently, journal editors, in controlling systems of manuscript evaluation and selection, occupy *powerful strategic* positions in the collective activity of their discipline. The practices and preferences which they adopt in their roles as editors are therefore of considerable significance."[2]

In an earlier paper[3] the same author had said "editors and referees who control the access to the coveted pages of scientific journals, particularly those who 'gatekeep' for the more prestigious publications, hold *vital strategic* positions in the orchestration of science."

There are three main groups of questions we consider of paramount importance in the whole complex problem of editorial gatekeeping in journals.

1. How does this gatekeeping system function and on what criteria do journal editorial board members base their decisions?

2. What is the structure of the powerful body of journal gatekeepers? In other words, who are chosen to perform gatekeeping tasks, and to which countries do they belong?

3. How can the evaluators be evaluated? In other words, what special characteristics give these individuals the right to sit in judgement?

In the present paper we concentrate on gatekeeping in analytical chemistry publications, to try to find answers to the last two questions.

We are not dealing with the first question, as we think that there is no answer to it that is specific to analytical chemistry. The gatekeepers of analytical chemistry journals use criteria similar to those used by science journal gatekeepers[4] in general, and these criteria have been quite thoroughly investigated.[2]

To find answers to the other two questions we have analysed the national composition of gatekeeping boards of analytical chemistry journals, and sought correlations between the number of gatekeepers, their citation rates and the number of analytical papers published by scientists from the country in question. A comparison has been made of the citation rates of the gatekeepers of organic chemistry, inorganic chemistry and analytical chemistry journals, and the citation data for the gatekeepers of analytical chemistry journals have been scrutinized.

EXPERIMENTAL

As a data-base, 14 analytical chemistry, 9 organic chemistry and 4 inorganic chemistry journals—considered among the most significant in their respective fields—were chosen.[5] The group of analytical

*The term "gatekeeping" is due to D. Crane, *American Sociologist*, 1967, **2**, 195.

chemistry journals was further divided into a subgroup of 7 broad-based analytical journals that deal with all branches of analytical chemistry[6] and 7 specialty journals. The inter-relationships between these two groups of journals were discussed in our previous paper dealing with the information flows in analytical chemistry.[7]

The broad-based journals were Analytical Chemistry, Analytical Letters A and B, Analusis, Analyst, Analytica Chimica Acta, Microchimica Acta and Talanta. The specialty journals were Chromatography, Journal of Chromatography, Journal of Radioanalytical Chemistry, Journal of Thermal Analysis, Radiochemical and Radioanalytical Letters, Spectrochimica Acta, Part A and Spectrochimica Acta, Part B.

These journals were examined with respect to the nationality of their gatekeepers. We considered as gatekeepers the editor(s)-in-chief, the editor(s), the managing editor, and the members of the editorial and advisory boards, but not the technical editor(s).[4] For the characterization of publication activities of the various countries in the field of analytical chemistry, papers published in the 14 analytical chemistry journals in 1978 were counted and grouped according to countries. In that year 1560 papers were published in the 7 broad-based journals and 3610 in the whole group of 14 analytical chemistry journals considered.

As a measure of "effectiveness", "eminence", "impact", "importance", "influence", "quality", "significance" or "utilization" of the scientific work of the gatekeepers,[8,9] the number of citations was considered. As a data-base the 1970–1974 cumulative volumes of the Science Citation Index[10] published by the Institute for Scientific Information (ISI), Philadelphia were chosen, and the citations under the gatekeepers' names were counted.

RESULTS AND DISCUSSION

National distribution of gatekeepers of analytical chemistry journals

Table 1 shows the national distribution and citation counts of the gatekeepers for the chosen analytical journals. The number of gatekeepers from various countries and their specific citation rates vary between wide limits. About half of the gatekeepers for analytical chemistry journals originate from only four countries (U.S.A., U.K., France and F.R.G.).

In co-opting scientists for journal gatekeeping functions, many points of view are probably taken into account. Here we would limit attention to only two factors affecting the "visibility" of an individual with regard to selection as a potential gatekeeper, namely publication productivity in some broad-based or specialized analytical field, and the impact of the research.

Accordingly correlations were sought, on the one hand between the number of gatekeepers from a given country and the number of papers published yearly in the two groups of journals (broad-based and specialty) from that country, and on the other between the number of gatekeepers and their citation rates. The results are shown in Fig. 1 as log–log plots; r and m represent the correlation coefficient and the slope, respectively. The overall correlation coefficient is $r = 0.8$. It appears that the two factors examined have an equal effect upon the selection of the gatekeepers.

The value of m in the relationship $y = ax^m$, *i.e.*, the exponent of publication productivity of quality, is usually below 1.0, its mean value being 0.71. This shows that the relationship is non-linear, in other words, to increase the number of gatekeepers from a given country, a progressively larger effort is necessary.

Along with the regression lines the standard deviation limits are also shown. Those cases that fall outside these limits are regarded as deviating significantly from the general group behaviour. For instance, taking the broad-based analytical journals as an example (Fig. 1b), the U.S.A., U.K., France, Belgium, Switzerland and Denmark give more gatekeepers than would be expected from their publication activity. In the citation rates of the gatekeepers of the same journals it is again the U.S.A., U.K., France and Belgium that figure foremost, along with Canada, the Netherlands and Italy. On the editorial boards of the broad-based analytical chemistry journals, India, South Africa and Israel are relatively under-represented.

Journals and gatekeepers in other subfields of chemistry

The impact factors*[11] of chemistry journals differ over about the same relative range as the citation rates of their gatekeepers. Do the scientific quality and distinction of the gatekeepers have a repercussion upon their gatekeeping activities?

We have tried to provide an answer to this question by comparing the impact factors of the journals with the citation rates of their gatekeepers. The data were taken from a previous paper.[12] Tables 2–4 contain data for organic, inorganic and analytical chemistry journals, respectively.

The citation frequencies of the gatekeepers are roughly in ratio 3:2:1 for the organic, inorganic and analytical chemistry journals, whereas the average impact factors are almost the same for the organic and inorganic journals, and that for the analytical journals is only about 25% lower (Table 5). These differences in impact factor are not significant. Figure 2 shows a plot of the data. Between the

*The impact factor is the number of citations in a given year to the papers published in the journal in question during the preceding two years divided by the number of those papers.

Table 1. National distribution and citation rates of gatekeepers of broad-based and specialty analytical chemistry journals: citation rates are given as the average number of citations per gatekeeper over a 5-yr period (1970–1974) and were rounded off by the program used

		Analytical chemistry journals		Broad-based analytical chemistry journals		Specialty analytical chemistry journals	
Rank*	Country	No. of gatekeepers	Citation rate	No. of gatekeepers	Citation rate	No. of gatekeepers	Citation rate
1	USA	154	220	81	260	73	180
2	UK	75	240	49	165	26	370
3	France	59	90	40	85	19	90
4	FRG	31	230	13	120	18	305
5	Hungary	30	120	5	415	25	65
6	Czechoslovakia	24	120	2	310	22	95
7	USSR	23	375	6	685	17	255
8	Japan	19	325	9	285	10	360
9	Canada	19	220	10	105	9	360
10	Belgium	18	75	12	80	6	60
11	Italy	17	95	4	30	13	115
12 eq	Switzerland	15	165	8	170	7	160
	Austria	15	120	6	115	9	130
14	The Netherlands	14	90	6	50	8	120
15	Sweden	12	300	8	320	4	260
16	Australia	9	290	7	345	2	120
17	Poland	8	150	4	235	4	65
18	Denmark	7	345	6	345	1	345
19 eq	GDR	6	85	2	120	4	70
	Israel	6	390	2	495	4	345
	South-Africa	6	330	2	845	4	70
	Yugoslavia	6	140	2	50	4	180
23 eq	Brazil	5	65	2	55	3	90
	India	5	260	1	140	4	290
	Roumania	5	300	3	200	2	440
26 eq	Mexico	3	1	2	1	1	1
	Norway	3	67	1	35	2	85
28 eq	Greece	2	36	2	35	—	—
	New Zealand	2	123	1	110	1	135
	Spain	2	15	—	—	2	15
31 eq	Egypt	1	—	1	—	—	—
	Argentina	1	7	—	—	1	7
	Other	6	15	5	20	1	2
	Total	608		302		306	
	Average		193		200		162

*According to the number connected with all 14 analytical chemical journals.

specific citation rates of the gatekeepers and the impact factors of their journals there is a significant correlation ($r = 0.6$). The slope of the regression line is 0.4, which means that the prestige of journals is only slightly raised by increasing the prestige of the gatekeepers.

The distribution of the gatekeepers of various countries and their citation rates is uneven, just as is the distribution of the scientific productivity,[13] area and national wealth of these countries. The Lorenz curve is a graphical presentation of the concentration, *i.e.*, the inequality of distribution, of various items over a population. A point on the Lorenz curve shows what percentage of the countries examined are endowed with a given percentage of the item plotted on the vertical axis. For example, in Fig. 3a we see that 25 (*i.e.*, 60%) of the 42 countries* dealt with can muster between them only 8% of the gatekeepers of broad-based analytical journals, the remaining countries having the other 92% of the gatekeepers. In this way Fig. 3 tells us that 72, 80 and 83% of the editors, and 74, 90 and 96% of the gatekeeper citations of analytical, inorganic and organic chemistry journals, respectively, stem from only 8 countries.

In the Lorenz-type graphs an even distribution is represented by the diagonal. The divergence of the Lorenz curve from the diagnonal is reflected in the Gini index, which is a measure of the normalized area between the diagonal and the Lorenz curve. It ranges from zero, *i.e.*, complete equality, to unity, *i.e.*, total inequality.

Upon comparing the Gini indices shown in Fig. 3 it becomes clear that the greatest inequality in the distribution of the citation rates of the gatekeepers appears for the inorganic and organic chemistry journals, $G = 0.81$ and 0.86, respectively. On the

*Forty-two countries are represented in the editorial boards of the international chemistry journals.[12] Our data are also referred to 42 countries in the case of analytical, inorganic and organic chemistry journals.

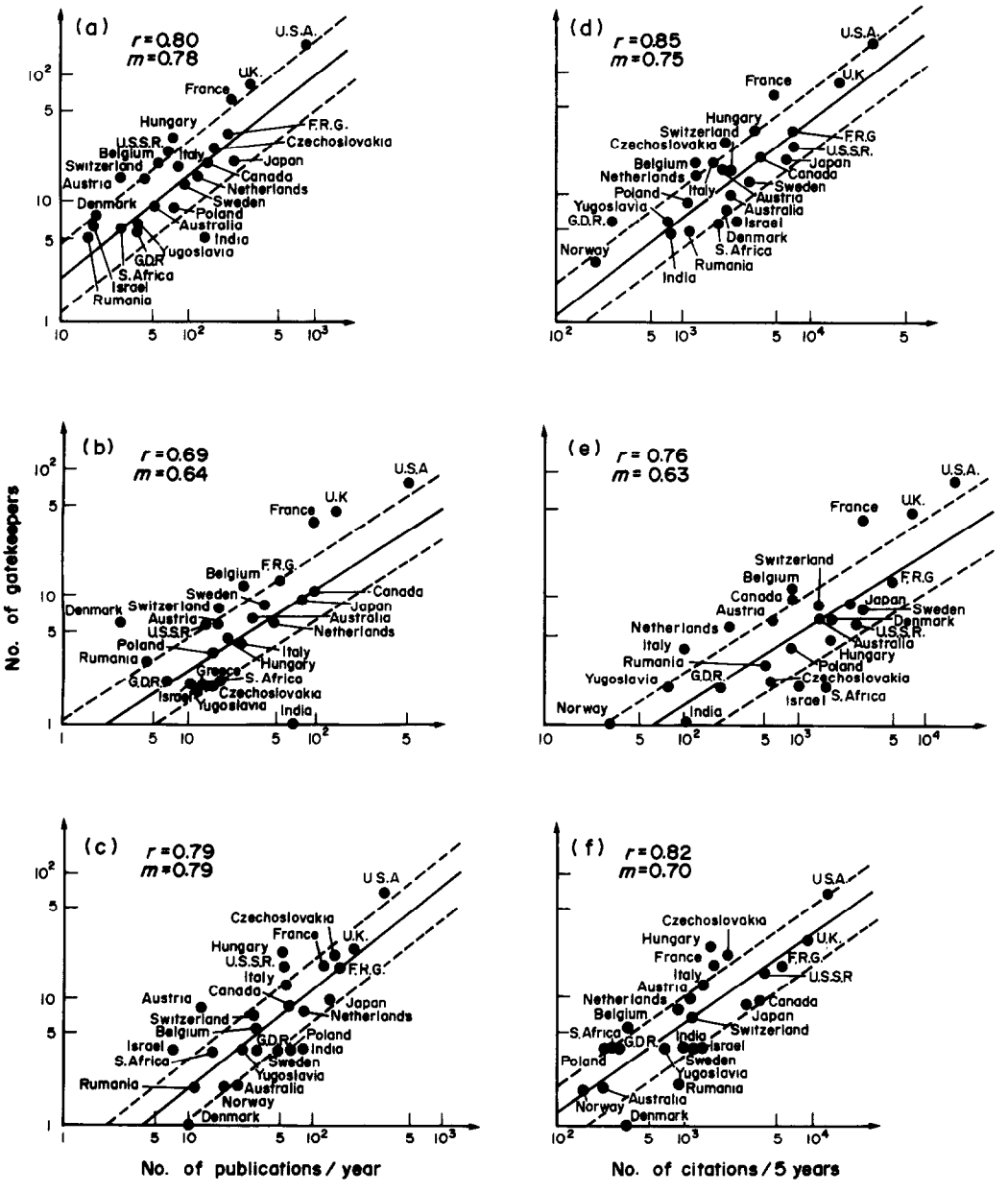

Fig. 1. Relationships between the number of gatekeepers and the number of pulications for a given country (a–c), and between the number of gatekeepers and their citation rates (d–f) for 14 analytical chemistry journals (a and d), 7 analytical chemistry journals of broad-based character (b and e) and 7 specialty analytical chemistry journals (c and f).

other hand, the national distribution of the gatekeepers of specialty analytical chemistry journals is the most even ($G = 0.62$). For comparison, the Gini-index of world scientific publication productivity is $G = 0.91$; the indices for the distribution of total national production and of population are $G = 0.85$ and 0.75, respectively.[13]

*"For unto every one that hath shall be given, and he shall have abundance: but from him that hath not shall be taken away even that which he hath" (Gospel according to St. Matthew).

The gatekeepers of analytical chemistry journals

Participation in gatekeeping for some scientific journal represents a form of reward for the person involved. Participation in many journals is naturally a cumulated reward, and in such cases no doubt the "Matthew-effect" is at work.[14]* It has been shown that scientists who are already known, *i.e.*, more "visible", are given more reward than others who may have similar scientific achievements but are less "visible" and/or less widely known.

Among the 608 gatekeepers of the 14 analytical

Table 2. Impact factors of organic chemistry journals and citation data for their gatekeepers

Journal	Impact factor	Gatekeepers No.	Gatekeepers Total citations	Gatekeepers Citations *per capita*
Carbohydrate Research	1.431	53	6638	125
Journal of Organometallic Chemistry	2.331	7	9888	1413
Monatshefte für Chemie	0.831	38	13584	357
Organic Magnetic Resonance	1.379	39	16553	424
Organic Mass Spectrometry	1.253	37	15178	410
Synthesis	1.758	24	27026	1126
Synthetic Communications	1.178	30	18360	612
Tetrahedron	1.745	71	60285	849
Tetrahedron Letters	2.114	65	60097	925

Table 3. Impact factors of inorganic chemistry journals and citation data for their gatekeepers

Journal	Impact factor	Gatekeepers No.	Gatekeepers Total citations	Gatekeepers Citations *per capita*
Inorganica Chimica Acta	2.859	79	42130	533
Inorganic and Nuclear Chemistry Letters	1.141	26	14441	555
Journal of Inorganic and Nuclear Chemistry	1.017	73	28635	392
Zeitschrift für anorganische und allgemeine Chemie	1.333	38	15220	400

chemistry journals considered, 61 are members of two editorial boards, and 19 participate in three or more.

The citation rate of gatekeepers of analytical chemistry journals can be well described by a logarithmic normal distribution curve (Fig. 4). The median corresponds to $M = 100$ citations per 5 yr; in other words, 50% of the gatekeepers receive over 20 citations per year, whereas 68% of them get between 3 and 100 yearly citations ($M \pm \sigma$).

CONCLUSIONS

The results of our study can be summarized as follows.

1. In the case of analytical chemistry journals, whether broad-based or specialized in character, a correlation has been shown to exist between the number of gatekeepers of a given nationality, and the number of analytical papers published in these groups of journals by scientists in the country concerned.

2. For the journals of analytical chemistry a correlation also exists between the number of gatekeepers and their citation rate. This correlation is of about the same strength for broad-based and specialized analytical chemistry.

3. The relationship between the number of gatekeepers (n) and their publication productivity, (*i.e.*, their citedness rate, N) is $n \sim aN^m$, where m shows values between 0.6 and 0.8. In other words, for the journals mentioned so far, the effort needed for a country to increase its number of gatekeepers by one, say from 50 to 51 or from 100 to 101, would be twice

Table 4. Impact factors of analytical chemistry journals and citation data for their gatekeepers

Journal	Impact factor	Gatekeepers No.	Gatekeepers Total citations	Gatekeepers Citations *per capita*
Analytical Chemistry	2.803	17	3193	188
Analytical Letters Parts A and B	0.884	62	15471	250
Analusis	0.774	50	6169	123
The Analyst	1.702	42	8664	206
Analytica Chimica Acta	1.488	40	7795	195
Chromatographia	1.394	33	8978	272
Journal of Chromatography	1.846	46	11543	251
Journal of Radioanalytical Chemistry	0.890	49	4535	93
Journal of Thermal Analysis	0.506	34	3625	107
Mikrochimica Acta	0.779	42	8830	210
Radiochemical and Radioanalytical Letters	0.515	74	6546	88
Spectrochimica Acta, Part A	1.023	34	5589	164
Spectrochimica Acta, Part B	1.621	33	15527	471
Talanta	0.907	51	10831	212

Table 5. Comparison of organic, inorganic and analytical chemistry journals (mean and standard deviation)

Characteristics	Organic chemistry	Inorganic chemistry	Analytical chemistry
Average impact factor	1.56 ± 0.47	1.59 ± 0.85	1.22 ± 0.62
Average number of gatekeepers per journal	40 ± 20	54 ± 26	43 ± 14
Average citations per gatekeeper	693 ± 415	470 ± 85	202 ± 97

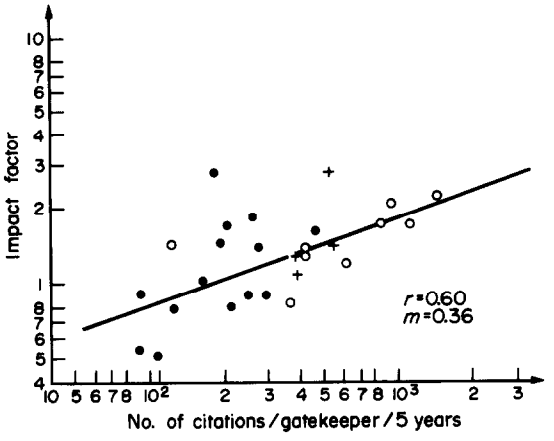

Fig. 2. Correlation between the citation rate of gatekeepers and journal impact factors: ● analytical chemistry, ○ organic chemistry, + inorganic chemistry.

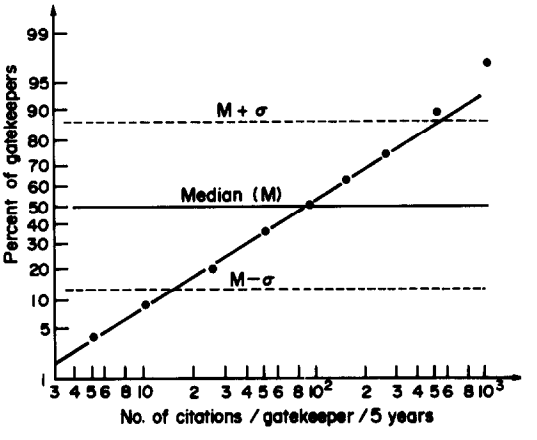

Fig. 4. Distribution of the number of citations for gatekeepers of journals in analytical chemistry, plotted on Gauss paper with logarithmic abscissa.

and thrice, respectively, as large as that necessary to effect an increase from 10 to 11.

4. There is yet another correlation between the impact factors (I.F.) of the journals and the citation rates of their gatekeepers. In the relationship $n \sim b\,(\text{I.F.})^m$, the exponent $m = 0.4$ is smaller than in the corresponding relationship involving the number of gatekeepers. The citation rate of the gatekeepers is therefore reflected in the impact factors of the journals.

5. The citation rates of the gatekeepers of organic and inorganic chemistry journals are 3 and 2.5 times (respectively) those for the gatekeepers of the analytical chemistry journals, and the impact factor of the latter journals is about 0.3 below that for the other two types of journal.

6. Of the 608 gatekeepers of analytical chemistry journals, 237 have an average citation rate of more than 20 per year, 113 have over 50 citations per year, and 58 are cited more than 100 times a year. The quality or impact of their research has an immediate effect on the prestige (impact factor) of the journals. Among the 608 editors, 61 are members of more than one, 19 of more than two, and 9 of more than three boards of analytical chemistry journals.

Our results show that 75% of the positions of power influencing the publication of new results in almost all areas of analytical chemistry are concentrated into the hands of scientists from no more than ten countries of the world.

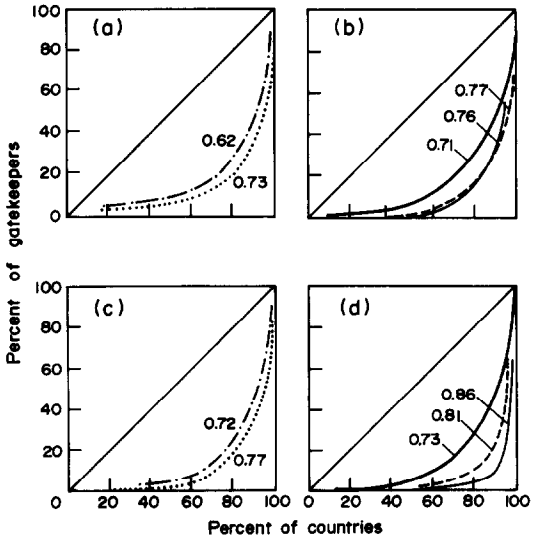

Fig. 3. Lorenz curves for the national distribution of gatekeepers of various groups of analytical chemistry journals (a and b), and of their citation rate (c and d): ··· broad-based; -·-·- specialty; —— analytical chemistry (the sum of the first two groups); —— organic chemistry; --- inorganic chemistry. The corresponding Gini indices are also shown.

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