Studies in Scientometrics I
Transience and Continuance in Scientific Authorship

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ABSTRACT

Investigation of the transience/continuance phenomenon occurring at a research front. The annual output of authors in a random sample derived from seven years data from Science Citation Index *and* Who is publishing in Science *was analysed. In the whole period (1964-1970) there are 281 transient authors and 19 continuant authors, for a total population of 506 authors. By deriving a quantitative model for the author flow pattern analysis, it was shown that there is a birth rate (annual recruitment) and a death rate (annual termination) which overlap to give an infant mortality (transience). By refining the model, it was possible to define a core of continuant authors, which amounts to 20% of those publishing. The transient authors constitute 22% of the annual population and 2/3 of the newcomers to publication. The other identified components of a scientific community are the recruits, terminators, non-core publishing continuants and non-publishing continuants. These demographic properties are clearly associated with the lowest and highest rates of authors' productivity, the distributions of which folkw Lotka's and Price's laws with great regularity. Thus it was possible to derive a lifetime expectancy at the research front which will be proportional to the time of active publication. On one end of the scale there is a majority of authors with a minimum life expectancy and a low average productivity (75% of the authors produce 25% of the papers); at the opposite extreme there are authors in the permanent nucleus (20%) with less average mortality and greater average productivity (more than half of the papers) All this is a result of the positive feedback or Mathew Principle in scientific publication. This situation seems so intrinsic that it must be regarded at the way in which society has adjusted its institutional structure to fit the cloth of scientific productivity and demography.*

Many of the richest areas for research in the sociology of science depend upon some understanding of what may be called the actuarial statistics of the scientific community. One needs to know the dynamical processes which govern emergence, survival and disappearance within that community. These determine the structure of the group by age, status, productivity, reputation and professional ties. Such studies have many of the same strengths and limitations as acturial methods in demography and life insurance.

Useful calculations may be made about the population in the large, but the bearing of the life of any individual remains statistical rather than causal. The purpose of this investigation is to uncover the facts and regularities which will require some theoretical explanation. Undoubtedly the most important phenomenon, hitherto not well recognized, is that at any given time a large number of those working at the research front are transients_whose_names have never appeared before and will not appear again in the record. The point has obvious application to the natural history of scientific careers, and it is also of fundamental importance to the analysis of manpower data in the sciences, since only part of the research labor force can be considered as stable.

Previous work in this areas has usually been based upon hand or machine counts that have been limited to a single nation, a scientific specialty, or just one journal or scientific institution. The results have always been of questionable generality because of possible strong idiosyncracies of these special groups and also because of the large general movement that exists across the boundaries of such groups as people change jobs and migrate through fields. We have been fortunate in having at our disposal data emerging as a by-product from the machine handling of a uniquely comprehensive and worldwide coverage of the literature in all fields of basic and applied science. For this reason the results are relatively free of local idiosyncracies and are of general applicability to the scientific community.

The data bank for this study was based upon volumes published by the Institute for Scientific Information, including several years of output of the *Science Citation Index*, with its indexes of Source Authors and Cited Authors, and the annual volumes of *Who is Publishing, in Science* which is derived from the weekly editions of *Current Contents."* These indexes cover all the principal journals. The criterion for inclusion is that of usage by the scientific community; many known journals are excluded, particularly local and domestic periodicals, but only because scientists do not cite them at all in subsequent research publication.

To manipulate the entire data bank, derived from more than 2000 journals and amounting to millions of citations each year would have been far too costly and complicated and would Lave excluded any possibility of hand collations and editing which is essencial in work of this kind. We therefore devised the simple technique of generating a small but random intercomparable sample of all indexes by taking only those authors whose names fell into a limited slice of the alphabetic listing. The range was chosen after several trials to begin with a person whose work was known to us and to extend for about 100 names in the first index covered. We were careful that the selection did not happen to include, so far as could be detected, any wildly pathological bias toward authors of any particular national or linguistic group. It contained no wellknown family active in science, nor any common surname that would pick up several different individuals for a single set of initials. Our final selection was the slice from *Pah A* to *Palecek* M which corresponds to about 0.22 =/= 0.02 percent of the entire author index in any of the many lists searched. By studying in detail a group of about 500 individuais drawn in this way from indexes dating from the period 1964 — 1970 we were therefore sampling a total population of a little more than a million scientific authors in all the countries of the world. This is a size consistent with most known estimates of the total world population of all research scientists and engineers. The names of every author on each paper are fed into the Source Indexes, so each annual record contains a listing of the scientific population, new and old, whose names are on the bylines of all papers published during the previous year. The total number of different names so recorded in the seven years was 506, and the annual totals increased in the usual exponential fashion, starting from 96 in 1964 and almost doubling to 187 in 1970. It should be noted that this doubling in seven years (a growth rate of 10% per annum) is only partly due to actual increase in the scientific population; probably some 3 or *4%* of the

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T A B L E I

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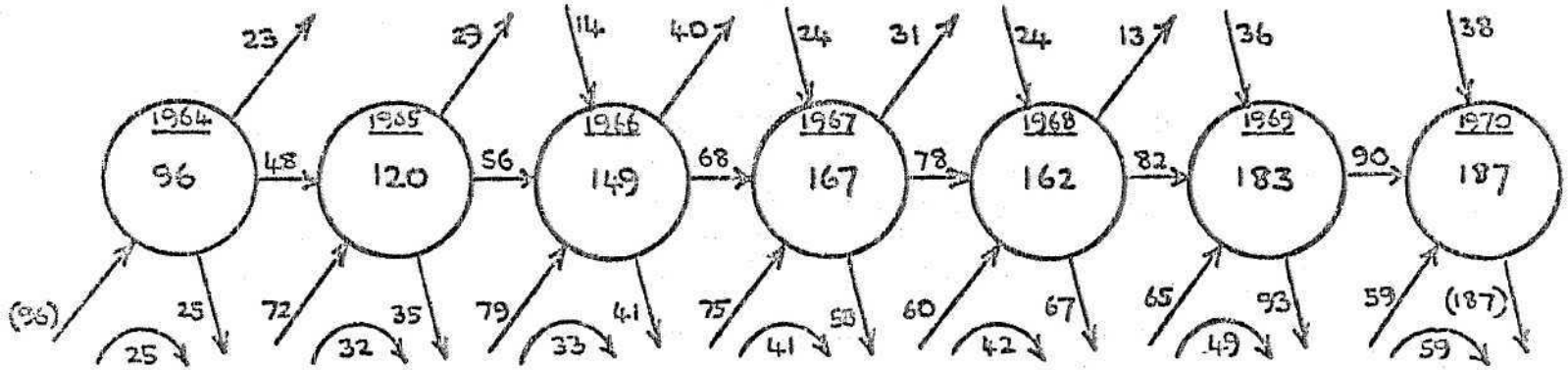


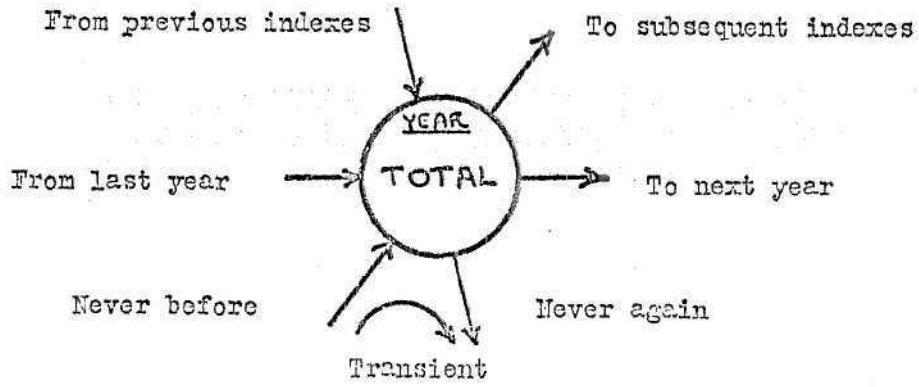


Figure 1. Flow of source authors through seven consecutive annual indexes

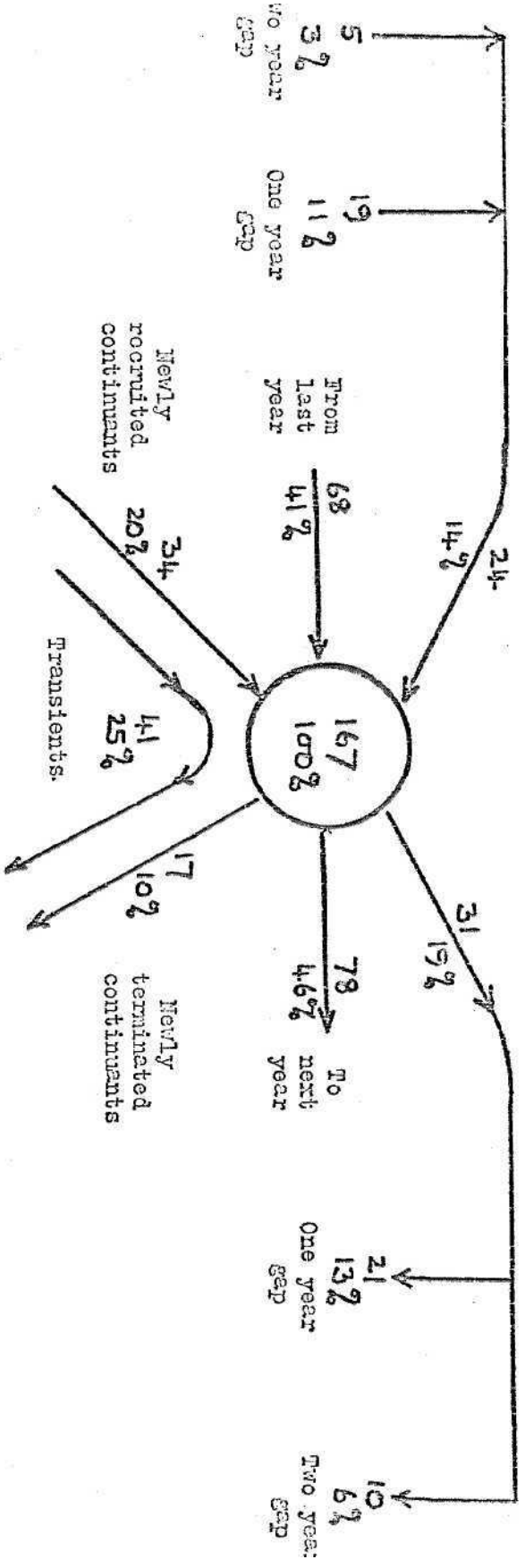
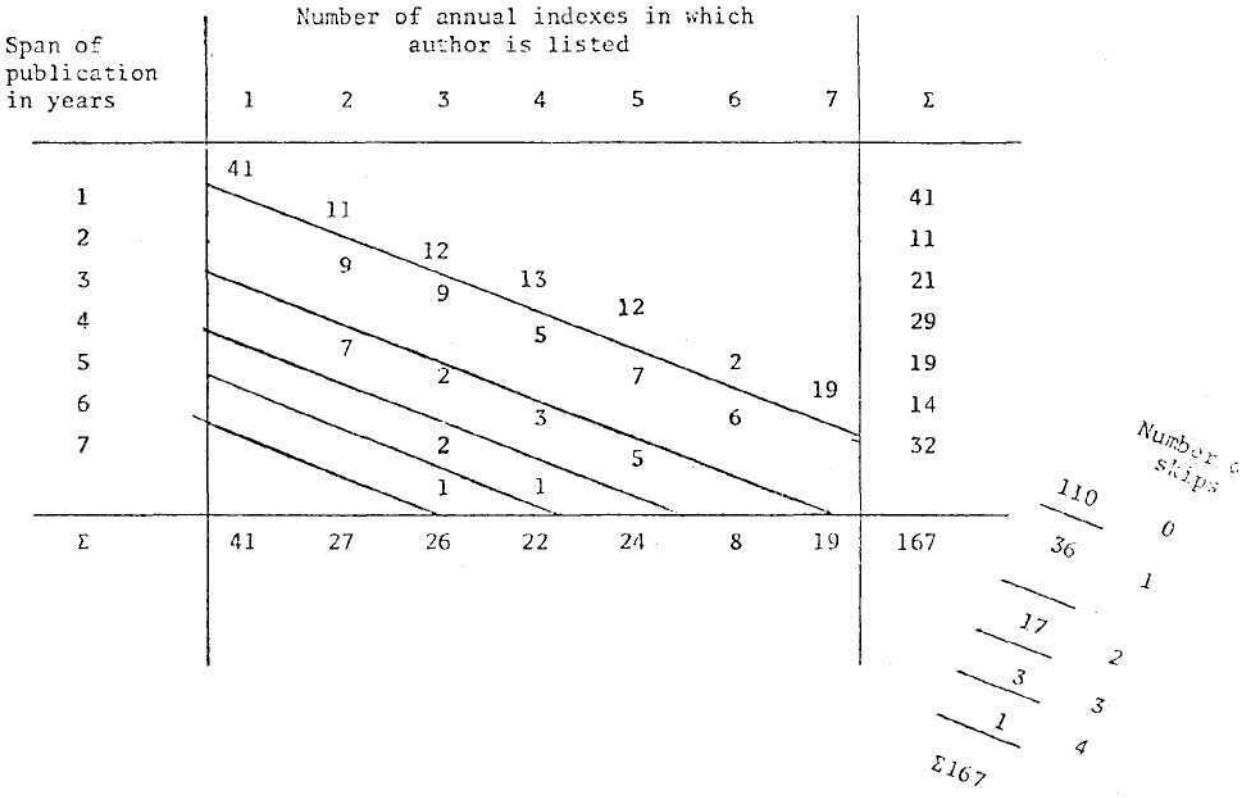


Figure 2. Empirical data for flow of source authors in 1967



Authors publishing in 1967

growth is due to increased coverage of the I.S.I. services as journals were added to the source list. The raw data emerging from this study are displayed in Table I which shows the number of authors who were listed in each of the possible combinations of years. It can be seen immediately that there is a certain tendency towards extreme behavior; authors seem to lean towards either publishing in only one single, year, or publishing in all available years. The results can also be summarized in a diagram which shows for each year the number of authors publishing in that year, the contribution to this by authors publishing before and not before, and the number of authors who publish subsequently and not subsequently. Figure I shows this flow, the authors being broken down into those who publish in adjacent years, and those who skip a year or more before or after the year of publication in question. The figure also shows separately those who fall in the category of not having been recorded before *and* not subsequently.

In each year studied those in this latter category of authors who have never been heard of before and never are heard of again amount to about 25% of those recorded for that year. They are surprisingly numerous and, of course, the proportion of them in the total population increases with the span of years considered because the rest of the authors' names occur in two or more years. In the whole period of seven years there are 281 names that occur in a single source index out of the 506 authors listed, a fraction of 56% of the population. We shall call this phenomenon *transience* and such authors *transients.* It is important to note that these cannot be people who have migrated to a different field of research, for the corpus includes all published fields of science and technology, all institutions and countries.

The opposite behavior pattern to transience, that of authors whose names tend to appear year after year in every index of the record, we shall call *continuance.* For the seven year period there are 19 such authors, and though they are but a small proportion of the total population of authors for all those years together, they constitute 20% of the pool of authors recorded at the beginning of the period in 1964. Such strongly continuing authors are clearly those who normally publish much more than a single paper a year so that their chance of skipping a year is very small. There must be many more whose continuance is slightly less because of a somewhat smaller production rate or an occasional subbatical or period of work on a book or extensive monograph.

By the same token we shall need to weaken the definition of transience, for there must be some otherwise transient publishers whose single research front production happens to appear in two or even three papers that fate and publishing time-lags decree shall come out in journals falling into two adjacent annual gatherings. The basic fact is however that nearly half the authors on an annual index are either strongly transient (25%) or strongly continuant (20%) so that they will continue to publish each year for the next six years. The remaining 55% of the annual author list consists partly of those who are more weakly transient or continuant, and partly of those who are newly recruited or newly terminated from the continuing community.

To derive a better quantitative analysis of the author flow pattern it is strategic to base an initial approximation upon the central year of the series, 1967, for which one has records that can detect authors whose continuance is so weak that they reappear after as much as two consecutive years of skipping publication. The general pattern of flow

is shown in Figure 2. The transients account for 25% of the population, or to put it into demographic terms, there is a *25%* infant mortality, over and above a birth rate of 20% and a death rate of *10%*. To put it another way, there is a total birth rate of 45% and a death rate of 35% which overlap to give the transients. Just over half the authors in this year have been previously recorded, 41% in the immediately prior year, another 11% after skipping one year, and *3%* after a skip of two years, the total being 55% but these 10% terminate their publishing in this year so that only 45% of the previously established authors will continue. These are augmented by 20% of the population who are new recruits, and the resultant 65% go on to publish, 46% of them in the next year, 13% after a gap of one year, and another 6% after a two year gap.

To emphasize the magnitude of the transience phenomenon, it may be noted that in this first approximation they constitute 25% out of a total birthrate of *45%, a* fraction of 0.56 of all births; similarly they are 0.71 of all the deathrate. These figures must however be modified a little because there exist small groups of authors who publish again after skipping more than two years of index. The effect of this is that a small amount of those who were here considered in the total birthrate must in fact be reckoned as authors reappearing after skipping three or more years, and correspondingly part of the assumed total deathrate is due to authors who will reappear after a gap of three or more years. Fortunately, skipping is a relatively uncommon phenomenon. For the group of authors publishing in 1967, the data summarized in Table II shows that 66% had a continuous record of publication, a further 22% had a single gap, and 10% had two gaps, leaving only *2%* with a gap of three or more

T A B L E I I I

a) *Of the 96 authors publishing in 1964*

25	do not publish again		26
48	proceed with no skips to	1965	50
14	skip 1 year, publish in	1966	15
5	2 years	1967	5
2	3 years	1968	2
1	4 years	1969	1
1	5 years	1970	1

b) *Of the 187 authors publishing in 1970*

59	have not published before		32
90	published with no skips in	1969	48
13	skiped 1 year, published in	1968	7
10	2 years	1967	5
12	3 years	1966	6
2	4 years	1965	1
1	5 years	1964	1

c)

Summary of data%	1964 & *after*	1970 & *before*	1967 & *before*	1967 & *after*
Not publishing again	26	32	45	35
Publish next year	50	48	41	46
1 skip	15	7	11	13
2	5	5	3	6
3	2	6		
4	1	1		
5	1	1		

years in the entire interval of seven years. Since in fact a full seven year period was studied it is possible to get data on larger gaps directly by starting from the first and the last years in the series. The results are shown in Table III. Clearly the frequency of long gap records is so low that it is heavily influenced by random noise. Taking the average of the 1964 and 1970 data we shall assume that gaps of three years occur for *4%* of the authors and gaps of four and five or more years with \% frequency for each. The series decreases so rapidly that we may safely suppose gaps of more than five years to be vanishingly rare; an author who has not published for the last six years may be considered as terminated. The *6%* of authors having long gap records must now be subtracted from the previous estimates of total birthrate and deathrate, so that we must now suppose the annual recruitment to be 45 - 6 = 39% and the annual termination to be 35 - 6 = 29%. The effect of this correction upon the magnitude of the overlapping area of transience is not immediately clear. The newly identified *6%* of large gap authors may be considered as those who were formerly thought to be transients, those who were apparently new recruits and terminators amongst the continuants, or as being equally divided amongst both classes of either the input or the output. The results are as follows: —

TABLE IV

Assumption	*a*		
Large gap authors are —	Recruits	Terminators	Transients
		(Percentages)	
— all transients	20	10	19
— nome transients	14	4	25
— distributed by all births	17	7	22
— distributed by all deaths	18	8	21

For our second approximation we shall take the mean of these four possibilities which is, in fact, given by the third line in which transients amount to 22% of any annual index of authors. They outnumber perceptibly the new recruits to the community of continuing authors, and they are more than double the natural rate of increase (birth rate minus death rate) for the scientific community. To put it very roughly, for every increase of one author in the continuant population it is necessary that about four new authors come into being; of these one replaces somebody who ceases to publish, two represent the infant mortality of those who arrive and depart from the research front in the same year, and the fourth survives for a greater or lesser lifetime of publication. Though this crude model needs much refinement and correction, the fact is clear that recruitment to the relatively stable community of continuing scientific authors proceeds in two stages. Reaching the research front and producing ones first paper — a process institutionalized in the United States by the Ph. D. — is only a first step. The large majority of those attaining this step are destined to proceed elsewhere than further research front publication in any scientific or technological field. Only a fraction, perhaps a quarter, of those reaching the research front cross the barrier from transience to continuance in production of scientific papers.

One obvious fact in the above model is that the 10% per annum growth rate in numbers of authors reflects the growth of the I.S.I, index over and above that of the population of authors. The average world rate of production of authors should almost certainly be nearer to 7% per annum resulting in a doubling period of about 10 years. A more serious fault is that we have only rough empirical values for the incidence of overlapping and gaps in the sort of year-to-year flow presented in Table III.

To develop a better model let us first consider the case in which there exists a fixed and stable continuant population, C, whose members year after year have a fixed probability p of publishing during that year, a corresponding probability 1 — p of not publishing. The number publishing in two consecutive years will be Cp^2, and the number publishing after a gap of one or more years will be Cp(1-p). Fitting this model to our empirical data as presented in Figure 2 and modified by the transfer of 6% from newcomers to those reappearing after long gaps, we have that the number coming from the previous year is *41%,* and the number reappearing after short and long gaps is 20%. Hence Cp^2 = 41% and Cp(l-p) = 20% from which p = 0.67 and C = 91%. We may take the convenient approximate values of p = 2/3 and 1-p = 1/3 and compute from this that the numbers appearing after gaps of 1, 2, 3, and 4 years should be 14%, 5%, 2%, 0.5%, all in rather good agreement

with the empirical data of Table III.c.
Our model therefore requires that in addition to the 39 newcomers and the 61 continuant publishers who exist amongst every 100 authors publishing in a given year, there are another 30 continuants who did not happen to publish in the year in question. The total "scientific" population of possible publishers is therefore 130 or 1.3 times the number that actually publish in that year, but 39 of these are newcoming transients and recruits, and of those remaining only 2/3 actually publish during the year.
Considering next the fact that our model must not be static, but subject to exponential growth, we note that by the end of the year in question the 91 publishing and non-publishing continuants have been augmented by the natural increase of 10 which is the excess of newcomers over terminators. There will therefore be now 101 continuants of whom 67 publish curing the next year and 33 do not. Of the 67 there will 45 continuing directly to the subsequent year and 22 who reappear after publishing gaps of one or more years. Again this is in good agreement with the right hand side of Figure 2, though as remarked already the I.S.I, data reflects a rate of increase that is higher than that of the scientific population. To improve the model further we would need data for the real scientific community, rather than as reflected by I.S.I, so as to replace the uncertain assumptions displayed in Table IV. Even if we would have some confidence in setting the actual excess of recruits over terminators at a *1%* rather than *10%* level, we would still need an estimate for the rate of termination. The biological process of retirement and death of the scientific population would yield a rate of about 2%, but almost certainly an equal additional amount must result from transfer from active publication to teaching, administrative, and other posts. With such an assumption (for which we can here adduce no empirical data) the model would have a recruitment rate of *11%*, a termination rate of *4%*, and a transience rate remaining at ea. 22% which would imply that 2/3 of all new entrants were transient, and that only 1/3 of those making their first appearance(s) in publication will enter the community of continuants. The total newcomers being 33%, there remains 67% for the publishing continuants at the beginning of that year, and to these must be added a supernumery 33% of continuants not publishing that year. The total body of continuants at the beginning of the year is therefore 100% and hence exactly the same size as the number of authors publishing, and the total

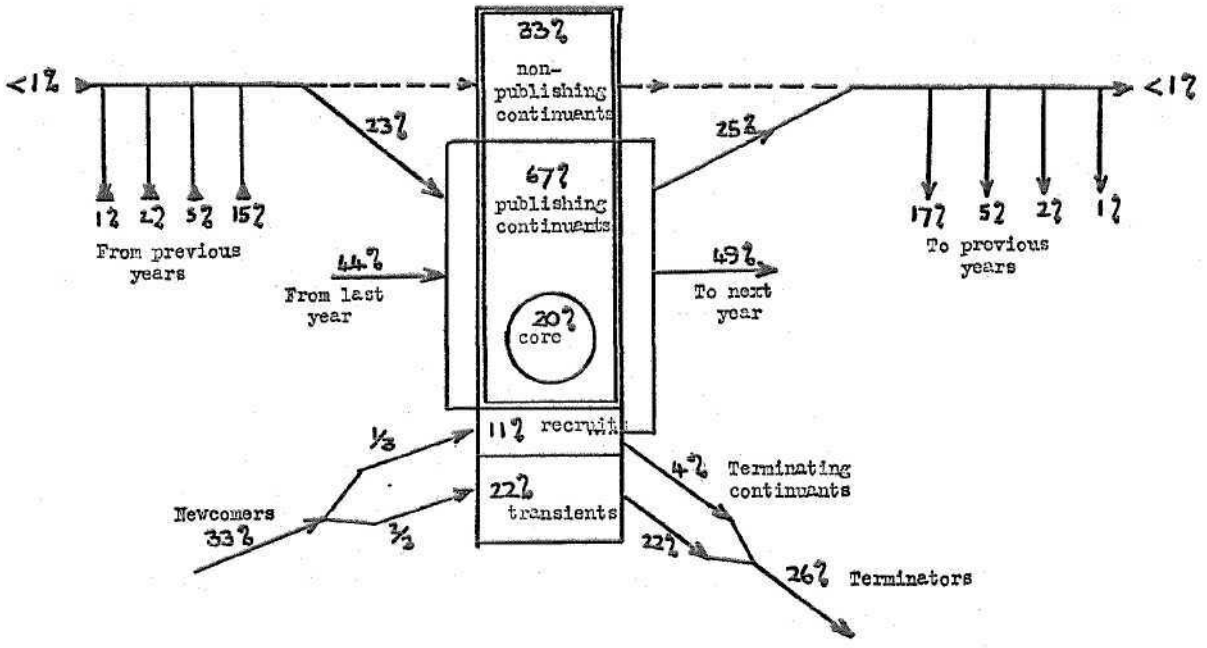


Figure 3. Improved model of flow of source authors

scientific communnity is 1.33 times that number, including transients, recruits, publishing continuants and no-publishing continuants. The complete flow pattern for this improved model is shown in Figure 3.

The agreement of this model with the empirical data is now excellent for the transients, the birth and death rates, and for the continuants who continue from one year to the next or have gaps in their publication records. It is still not quite adequate for the very strong continuants who persist for several years together. Of the 96 authors recorded in 1964 there are 19 whose names occur in all annual indexes through 1970. On the basis of a publishing probability of p = 0.67 for a continuant population of 96 there would be only 6 such people for the entire seven year period; to get •19 would require p = 0.79 for the whole continuant population. Alternatively one could say that there were 13 additional authors so strongly continuant that for them p = 1.0 so they were certain to publish in all years. From the data base we find the actual proportion of authors who persist for at least an n-year run, relative to the continuants at the beginning of the period to be as follows:

n	actual	expected
3	33	33
4	25	22
5	21	14
6	19	9
7	20	6

The expected proportions were all calculated on the basis of p = 2/3. It is apparent that the random probability model beggings to break down for runs of more than four years, and the constancy of the subsequent actual percentages makes it natural to suppose that there exists a hard core of highly persistent strong continuers who amount to about *20%* of the continuant population (they must also be 20% of the annual author list) and who publish without fail every year during their lifetime on the list. This core, it should be noted, is a considerable fraction 0.3 of all the publishing continuants, and 0.45 of these continuing from the previous year. No doubt the boundary between core and non-core continuant publishers is not completely sharp, but some graduation exists between those for whom the probability of publishing in any year is near unity and those for whom it is near the average value of 2/3; we shall retain the distinction as an aid to conceptualization. With this refinement the model now accounts for all of the empirical evidence from the data bank, and the components of the scientific community may now be summarily categorized as follows:

a) *Transients* who publish only during a single year and constitute 22% of those publishing this year, 2/3 of those newcomers to scientific publication during the year.

b) *Recruits* who begin publishing during the year and join the continuant population. They constitute 11% of those publishing, 1/3 of the newcomers.

c) *Terminators* who end their publishing during the year and thereby leave the continuant population. We have assumed they constitute about 4% of those publishing.

d) *Core continuants* who publish this year and indeed in every year for a long period. They amount to 20% of those publishing.

e) *(Non-core) Publishing continuants* who publish this year and have a probability of 2/3 of publishing in any other year for a long period. They amount to 47% of those publishing, so that the total of core and non-core publishing continuants is

f) *Non-publishing continuants* who also have a probability of 2/3 of publishing in any year over a long period but do not happen to publish in the year in question. They amount to 33% of those publishing, and this implies that the number of active researchers during the year is 1.33 times those actually publishing.

There is clearly a close relationship between the demographic structure that has now been elucidated and the distribution of productivity of scientific authors. Till now the data have been drawn from the mere appearance of an author's name in the series of annual indexes and not from the number of papers that he published in each year. The approximate average over the entire set of annual source indexes is that each author has his name on about two papers per year. Since however there are on the average also about two authors on the by-line of each paper it follows that the total number of authors is equal to the total number of papers. Thus although there is just one paper/author/year, there are about two authorships/author/year. Of these two authorships, about one is primary (i.e. the first author mentioned) and the other secondary — it is important to bear this in mind for citations to papers are listed to the primary author only. The demographic properties of transience and continuance are obviously to be associated with the lowest and highest rates of productivity respectively. For transience indeed, the publication is a one-shot event, and only formally do we

associate with it an interval of a year. The training and research leading up to the event may take a much longer period. In a separate investigation we considered the publication records of authors who remained on the indexes for various spans of years. Those transients with a span of a single year produced 1.1 authorships during that year. Those continuants with spans of 2, 3, and 4 years produced 1.5, 1.73, and 2.0 authorships/year, and the obviously core continuants staying for 5 years had 3.7 authorships/year. Going even further to a nine-year span (extending to 1972) for the core we found 4.3 authorships/year as the average for the group of 16 such authors. The continuants therefore have an average rate of production two authorships/year equal to the average of all the population, and the core continuants produce at about twice this average, balancing the transients with their minimal contribution of 1 authorship/ year. In our small sample the most prolific authors had 14, 8, 5, 5 and 4 authorship/author/year respectively. In general the range of productivities seems remarkably low, running not much more than a factor of two above and below the average for everyone but the most prolific couple of members of the core group. It is wellknown that the work content of what constitutes a publishable paper varies quite a lot from field to field and even perhaps from country to country. Allowing for this one might reasonably suppose that each of the three demographic groups have productivity factors that are not merely average but also typical. Transients appearing in a single year tend to produce a single authorship in that year. Continuants produce about two authorship (= one paper) and the core group about four authorship (= two papers) each year.

From this it follows that in any record extending over several years the numbers of papers produced by the various authors will depend more upon their lengths of stay at the publishing front than upon their rate of production while there. Unfortunately there is a basic difficulty in using such a long record to make deductions about the characteristics of the authors, The trouble is that at the beginning of such a record, and in the case of exponential growth, even more strongly at the end of the record, one is dealing with authors whose natural research lifetimes have been artificially cut. A cross-sectional study taken only over a given time range must contain a large number of authors whose careers began during that interval. For example a 10-year study contains equal numbers of those beginning publication during the interval and those already present at the beginning. Fortunately however there is now a great deal of evidence to show that such cross-sectional studies of productivity over reasonably long intervals of time follow rather simple laws with great regularity.* A first approximation is given by Lotka's Law which states that in any population the number of authors with *exactly* n authorship is proportional to $1/n^2$, and another form holding also for larger values of n is Price's Law which states that the number of authors with *at least* n authorship is proportional to $1/n(k + n)$ where k is a parameter of about 15 authorship/author/ lifetime which marks a boundary between very high and normal production. The proportion of authors having a single authorship only may be calculated from these laws, Lotka's form giving *61%* and Price's *53%*. Both values are perceptibly lower than the present demographic model in which we have settled on parameters such that 2/3 of all newcomers are transient, and hence there would be *61%* of single authorship authors. The demographic model could be reconciled with Lotka's Law by keeping transients at 22% and taking the non-transient recruitment rate as 14% and which Price's Law by taking it as 20%. These latter figures are indeed exactly those of the second and first lines respectively of Table IV and are the limits of what could be maintained from the empirical data of the present study. They were modified, it will be remembered only because it seemed excessive to have a 10% rather than a 7% per annum rate of increase and also excessive to allow a termination rate larger than *4%* per annum. In any case the changes introduced into the model by such variations of parameter are slight, they will have to be resolved in future work with larger samples of population which can be better specified now that a conceptual foundation has been laid for the chief demographic phenomena.

For those authors with more than a single authorship, the productivity laws seem to imply that the number of continuants with a given lifetime decreases with the length of that lifetime. Furthemore, the changeover in Price's Law at a parametric value of 15 authorships may well be identical with the demographic distinction that has been made between those cortinuants who are in the core group and those who are not. Clearly it should be possible to derive a lifetime expectancy function for paper publishers from the known productivity law. Just as the first year's publication record initiates one into authorship, and the second year's record selects the fraction who become continuants, so each successive year of publication reduces the ranks but makes it easier for those who succeed to continue. The final hurdle, that from continuant to core must occur after something like five years of work and the production of some 15 authorships.

A full account of these laws and reference to the relevant literature is given in Derek de Solla Price, *Little Science Big* Science, New York, 1963. p. 42-50.

We suggest that these demographic stages that have been diagnosed correspond rather well to the social and institutional barriers that pervade every field and country in which there exist scientific and technological publication into the world corpus of common knowledge. It has already been remarked that the first barrier of securing the ability and permission to publish at all is that which is institutionalized in the U.S.A. and U.K. as the Ph.D. degree. In other countries it may correspond with Candidacy or some other post-graduate qualification. The second barrier is probably that of first acceptance into an academic, governmental or industrial post in which at least part of the expected output is research front publication. The final barrier would seem to be that of the securing of tenure and seniority leading to a major lifetime commitment to research output and probably also the collaboration of junior continuants and transients.

It might at first be thought that the demographic structure that has been analysed is a direct consequence of the institutionalization that we now have. Two factors militate against this interpretation. In the first place it is quite clear that the productivity distribution of authors today is not essentially different from what it was for the seventeenth century science published in the early volumes of the *Philosophical Transactions of the Royal Society of London* long before the Ph. D. degree or the career scientists came into being. It seems therefore the phenomena of transience and continuance must have occurred first, and the institutionalization followed. In the second place the very form of the productivity distribution implies that behind the phenomenon of demographic stages separated by barriers, lies a continuous process of people gradually falling away from active publication.

It follows from Price's Law that the fraction of authors proceeding from a total of at least n papers to the level of 2n papers is $0.5(1-1/(2-k/n))$ where, as before k is a parameter of value about 15 authorships. From this it follows that the transition frequency for authors to double their total of authorships beings at 47% for the first paper, falls to 33% at 15 authorships, and then decreases slowly and assymptomatically to 25% for very prolific authors. Similarly for a multiplication of output by 1.5 rather than a doubling, the transition probability beings at 67%, goes through 53% at 15, and ultimately decreases to 44%. For very large outputs this law ultimately breaks down because of the death of the author.

Another way of looking at the same consequences of this law is to say that at the beginning an author has an even chance ($p = 1/2$) of multiplying his output by a factor of 1.89, by the time he has reached 15 authorships his even chance is for an extension by a factor of 1.56, and ultimately the factor is reduced to 1.41. In general the pattern of the productivity law is such that what remains rather constant for any author is his chance of increasing his total output by a given ratio. Since we know already that authors differ not so much in rate of production as in duration of stay in research publication, these results may be interpreted as probabilities for the extension of publishing lifetime by the various factors. Again, what remains approximately constant is the chance that an author will continue for some multiple of his present span of years in research publication. Thus life expectancy at the research front is proportional to the time already spent there; the mortality rate falls steadily and hyperbolically from the very high level it begins with in infancy. It is this steady force which produces both the productivity distribution and the demographic structure. For those beginning a publishing career the mortality is very high so that a majority of the publishing population fall in this category. With a minimal lifetime and a low rate of production it is easy to see that transients publish only a small minority of the totality of papers. In fact the *75%* of the population who are least prolific account for only 25% of the output. At the other end of the scale those authors who are so reinforced by successful publication that they have the smallest mortality and appear for a long succession of years also have a high rate of production and the output of this small core group. A core group of 20% of the continuants will probably produce more than half the total output.

All this is a result of the simple facts that success in scientific publication is extremely difficult to achieve and that breeds further success — a good example of positive feedback or the Matthew Principle. The consequence of this situation is a strongly hyperbolic distribution of productivity, and the consequence of that is that the unit beginning of the distribution and its long tail both tend to behave as distinct entities which have here been identified as the transients and the core continuants. If this interpretation is correct it seems so intrinsic that the institutionalization must be regarded as the way in which society has adjusted to the built-in pattern. For example the barrier between first publication and second has its value by virtue of the difficulty scale of successive publication rather than because of the availability of socially useful jobs. With the same hyperbolic distribution now as in seventeenth century England, it must be our society that has cut its various suits of institutional structure to fit the cloth of scientific productivity and demography.

RESUMO

Estuda o fenômeno de transiência/permanência na frente de pesquisa pela análise do fluxo anual de autores de uma população amostrada derivada do banco de dados resultante de sete anos de publicação de "Science Citation Index" e "Who is publishing in Science".
Para o período total analisado (1964-1970) foram encontrados 281 autores transientes e 19 autores permanentes, numa população total de 506 autores. Derivou-se, a seguir, um modelo para análise quantitativa do fluxo padrão de autores, verificando-se que há uma taxa de natalidade ("annual recruitment") e uma taxa de mortalidade ("annual terminatio") de cuja superposição resulta uma taxa de mortalidade infantil (transiência). O modelo final permite definir a existência de um núcleo de autores altamente permanentes, correspondente a 20% da população. Os autores transientes constituem 22% da população anual e 2/3 dos autores novos ("newcomers"). Foram ainda identificadas outras categorias de autores na comunidade científica.
Há uma clara correlação entre estas propriedades demográficas e as taxas (maior e menor) de produtividade dos autores, cuja distribuição é consistente com as leis de Lotka e Price. Isto permite derivar a expectativa de permanência na frente de pesquisa, que será proporcional ao tempo ativo de publicação. Temos de um lado da escala, a maioria dos autores com uma expectativa de vida mínima e taxa de produtividade baixa (75% dos autores produzindo 25% dos trabalhos); no lado oposto estão os autores do núcleo permanente (20%), com menor taxa de mortalidade e maior taxa de produtividade (mais que a metade dos trabalhos). Esta situação é resultante de um *feedback* positivo ou efeito Matthew — e parece ser tão intrínseca que, tudo leva a crer, nossa sociedade deve atingir de modo a adaptar sua estrutura institucional à feição da produtividade e demografia científicas.