What information explosion?

Maurice E. White

"What sort of reading will best help a man in his education, will help him to keep up with the times and to develop into a thinking, reasoning practitioner? Let him get rid of the notion that much has to be read; one or two journals, a good weekly — the *Lancet* or the *British Medical Journal* — a good monthly — the *Practitioner* or the *American Journal of the Medical Sciences* — suffice; but let them be read thoroughly.(1)

William Osler, 1909

To stay well informed, the average practitioner only needs to read a few, well-chosen periodicals: one or two general medical journals (weeklies) plus two or three specialty journals (usually monthlies). Naturally not everything of interest will be published first in those few journals, but, over the course of a year or two, nothing of importance is likely to be overlooked. Sooner or later, every significant development will have been covered, either in original research reports or in editorials, reviews, and other didactic articles. (2)

Arnold S. Relman, 1981"

Isn't there an information explosion in clinical practice? (3) In the years between the above statements by two of the most well-informed physicians of their generations, the growth of the medical literature probably followed that of the learned literature as a whole, with an exponential increase of about 6–7% each year, a doubling in size every 10–15 years, and a tenfold increase in every generation of 35 to 50 years since the 1700's (4). At that rate, during the interval between Dr. Osler's and Dr. Relman's comments, the recommendation that a practitioner read about five journal issues a month (a weekly and a monthly) should have swollen to a recommendation that the practitioner peruse 500–600 issues per month. Instead we have Dr. Relman's statement that 6–11 issues will suffice. Not much of an explosion; how can that be, when we have all heard about the information explosion and a visit to a library seems to confirm it? We have focused too sharply on the quantity of information published, and too little on its quality, its purpose, and how it is used. Let's look at some of the evidence that the clinical veterinary literature is not really that overwhelming.

We all specialize to some degree, which means that most of the biomedical literature outside our specialty is not of direct interest to us (5), but even within a specialty much of the literature is of minimal value. de Solla Price reports that if one collects useful journals, starting with the most prolific, the total cumulated journals increases only as the logarithm of the collected journals — a finding known as Bradford's law (6). This means that one might expect 90% of valuable information in 25% of sources. He states; "Given this situation, therefore, a small personal or institutional library, *if well selected*, is far more valuable than its proportion to the total literature suggests..." (6).

How well does the clinical veterinary literature follow Bradford's law? I recently repeated an analysis (updating one done in 1987 (7)) of information in the CONSULTANT database for computer assisted diagnosis. I examined a random sample of 1/3 of the database and ranked journal by frequency of citation. Tables 1 and 2 show the journals which provided a cumulative 90% of total citations for large or small animal diseases. As expected, there is a clustering of useful clinical information in a few journals. Thirty percent of large animal journals yielded 90% of citations, close to Bradford's law. In small animal medicine, there was more spread, with 38% of journals needed to obtain 90% of citations. Even so, only 15 small animal journals yielded 90% of citations, and just five produced 65% of them. In a recent letter to the editor of the Canadian Veterinary Journal, it was pointed out that the number of clinical journals at the Ontario Veterinary College library has gone from 17 before 1960 to 50 in 1988 (8). This is less than the expected doubling every 10–15 years, but is still a substantial increase. If we apply Bradford's law, about 90% of useful information could have been obtained from 25% of those journals; there were four "important" journals in 1960 and there are 13 now. This increase of nine important clinical journals in 28 years is quite modest. If we modify Bradford's law by using the figures from the analysis of CONSULTANT that showed about 1/3 of journals yielded 90% of the information, the growth is from 6 to 17. Even this modest growth is leveling off; the abstracts listed in each volume of the *Veterinary Bulletin* reached a peak in 1980 and have remained steady (9), and the number of new journals (e.g. Seminars in Veterinary Medicine and Surgery, Veterinary Medicine Report) seems balanced by the demise of old ones (e.g. Nord Vet-Med, Equine Medicine and Surgery).

We can approach the "information explosion" question from another angle, with concentration on one specialty, large animal practice. I once read the statement, which must remain unattributed as I cannot find the source; "If there has been an information explosion, where are the wounded who have been hit by shrapnel?" Has an explosion occurred in the knowledge base of the most common diagnoses and procedures in practice? Table 3 lists the 15 most common diagnoses and procedures from the year 1988 in the Ambulatory Clinic at Cornell. While we continue to learn more about all these subjects, does anyone really think there has been an "explosion" in knowledge regarding tuberculin testing or pregnancy examination? The core of knowledge in applied veterinary medicine is relatively stable. New informa-

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TABLE 1
Journals which provided 90% of citations for large animal diseases in a random sample of 1/3 of the CONSULTANT database

Name	Citations	Cumulative
J Am Vet Med Assoc	263	
Vet Clinics N A (all large animal combined)	193	456
Vet Rec	139	595
Compendium on Contin Educ Pract Vet	125	720
Am J Vet Res	87	807
Australian Vet J	86	893
Equine Vet J	63	956
Can Vet J	52	1008
Cornell Vet	50	1058
Vet Pathol (and Path Vet)	43	1101
New Zealand Vet J	27	1128
In Practice	21	1149
Bovine Practitioner	19	1168
Vet Med (and VM/SAC)	17	1185
Can J Vet Res (and Can J Comp Med)	16	1201
J South Afr Vet Assoc	16	1217
British Vet J	15	1232
Equine Practice	15	1247
J Dairy Sci	14	1261
Res Vet Sci	13	1274
Irish Vet J	11	1285
J Comp Pathol	10	1295
J Vet Intern Med	10	1305
53 other journals	148	1453

TABLE 2
Journals which provided 90% of citations for small animal diseases in a random sample of 1/3 of the CONSULTANT database

Name	Citations	Cumulative
J Am Vet Med Assoc	180	
J Am Anim Hosp Assoc	92	272
Vet Clinics N A: Small Animal	77	349
Compendium Contin Educ Pract Vet	71	420
J Small Animal Pract	65	485
Vet Med (and VM/SAC)	38	523
Vet Rec	29	552
Vet Pathol	26	578
J Vet Intern Med	16	594
Can Vet J	15	609
Am J Vet Res	14	623
Seminars in Vet Med and Surgery	12	635
Aust Vet J	11	646
Companion Anim Pract	10	656
Brit Vet J	9	665
25 other journals	82	747

tion is often at the margins of practice; there is time to keep up with it in the few important journals and books.

Indirect evidence for this latter view is available from a study done in human medicine. If there really if a "knowledge explosion", one of the most effective ways to cope with it might be continuing medical education. Researchers studied a random sample of 120 physicians in Ontario to assess quality of care in primary care and test an hypothesis that quality of care was related to continuing medical education activities. The researchers found no relationships between global quality-of-care scores and either the type or quantity of the physicians continuing medical education activities (10). The authors of that study stated; "There could well be a threshold phenomenon relative to physicians' need for CME to remain competent and up-to-date." That view is consistent with the idea that there is a modest amount of scientifically valid and clinically useful new information which can be obtained by a reasonable effort. In this age of computerized databases and abstracting services, even the useful article hidden in a relatively obscure source is easily available to the interested clinician or researcher.

I will close this piece as I began it, with a quote: "the fact of publication is less important than the pro-

TABLE 3
The 15 most common diagnoses and procedures, 1988, Ambulatory Clinic, New York State College of Veterinary Medicine, Cornell University

Procedure or diagnosis	Number
1. Reproductive examination, female	19142
2. Vaccination — polyvalent vaccine	3495
3. Tuberculin test	2023
4. Dehorn	1854
5. Blood test — brucellosis	1746
6. Vaccination — brucellosis	1249
7. Blood test — blue tongue	1236
8. Vaccination — leptospirosis	1168
9. Blood test — leptospirosis	940
10. Bloot test — infectious bovine rhinotracheitis	878
11. Vaccination — infectious bovine rhinotracheitis	502
12. Physical examination	469
13. Metritis	351
14. Mastitis	324
15. Physical examination for health chart	292

cesses of comment, modification and evaluation that each account of new work passes through during and after publication and that end with assimilation into the corpus of scientific knowledge. While allowing that the literature embodies great quantities of data and information, this view allows also for the fact that much of it may be unimportant or unoriginal; value resides not in the literature but on the consensus of ideas that experienced scientists create out of it" (11).

References

1. Osler W. The medical library in post-graduate work. In: McGovern JP, Roland CG, eds. William Osler, The Continuing Education. Springfield, Illinois: Charles C Thomas, 1969: 216.
2. Relman AS. Journals. In: Warren KS, ed. Coping With the Biomedical Literature, A Primer for the Scientist and the Clinician. New York: Praeger, 1981: 77.
3. Ward BC, Bushby P. Veterinary education in the information age. J Vet Med Educ 1986; 12: 39–41.
4. de Solla Price D. The development and structure of the biomedical literature. In: Warren KS, ed. Coping With the Biomedical Literature, A Primer for the Scientist and the Clinician. New York: Praeger, 1981: 5–6.
5. White ME. Let's stop loose talk about the "information explosion". J Vet Med Educ 1988; 15: 25–26.
6. de Solla Price D. The development and structure of the biomedical literature. In: Warren KS, ed. Coping With the Biomedical Literature, A Primer for the Scientist and the Clinician. New York: Praeger, 1981: 9–10.
7. White ME. An analysis of journal citation frequency in the CONSULTANT data base for computer-assisted diagnosis. J Am Vet Med Assoc 1987; 190: 1098–1101.
8. Prescott JF. More on the "information explosion". Can Vet J 1988; 29: 965.
9. Payne JM, Payne S. Changes in world veterinary output of publications. Br Vet J 1986; 142: 301–306.
10. Dunn EV, Bass MJ, Williams JI, Borgiel EW, MacDonald P, Spasoff RA. Study of relation of continuing education to quality of family physicians' care. J Med Educ 1988: 63: 775–784.
11. Dannatt RJ. Primary sources of information. In: Morton, LT, ed. Use of Medical Literature. Connecticut: Archon Books, 1974: 15.

Yes, veterinaria, there is a knowledge explosion[1]

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Introduction

My first dance with the knowledge expansion problem occurred while I was in a graduate program at a veterinary school. I presume that prior to that time, my professors had shielded me from having to deal with the knowledge magnitude problem. In retrospect, I can only remember their chronic lament; "There isn't enough time to cover this in class... read your book." As a teaching assistant I was thrown into the midst of wrenching departmental faculty discussions concerning the priorities in the physiology courses. It seemed to me at the time, that the debate was between the new-young-energetic faculty and the elder-wiser-careworn. I now believe the conflict was based upon a less romantic and more fundamental problem — THE KNOWLEDGE EXPLOSION.

Most of us are familiar with the now-classic book Megatrends (1) in which John Naisbitt discusses the impact of the knowledge expansion and describes the transition from an Industrial Society to an Information Society. He documents that between 6,000 and 7,000 scientific articles are written each day. I would presume

[1]Paraphrasing the editorial by Francis Pharcellus Church first published in the New York Sun September 21, 1897 in response to an inquiry from Virginia O'Hanlon. "Yes, Virginia, there is a Santa Claus", and like Santa Claus the Knowledge Explosion will live forever.