



FIGURE 1. SELECTED ARTICLES FROM THE LITERATURE ON THE DESIGN OF ELECTROMAGNETIC FLOWMETERS

edifying (meaning “instructive, to build up knowledge”) is chosen advisedly. There is insufficient evidence to justify the use of the word *milestone* in this example, although it seems likely that at least three of the edifying articles are also milestone articles.

In the defined circumstances of the search strategy adopted, the search was carried out by a non-subject expert who, starting with one known article and its references, was led to other articles. Other articles located thereby were determined to be relevant by examining their authors, titles, and references, and the *Science Citation Index*. The *Permuterm Subject Index* was also checked using the words *blood flowmeter*. By using this search process, about 500 articles were found of which about 159 were relevant, and the final network contained 26 articles.

The importance to the searcher of constructing a network of bibliographic citations is that it assists him in locating key papers and in tracing the historical development of a subject. The greater the number of citations to an earlier work, the greater the likelihood that this paper may be a milestone or key event in that subject field. Having constructed a citation network, the searcher can then check the *Citation Index* section of the *Science Citation Index* for further verification that these papers are in fact important papers because they are highly cited. For the historian and bibliographer undertaking a search or wishing to construct histories, the building of citation networks has particular significance. The compilation of bibliographies should be inseparable from writing the history of that field.

FOOTNOTES

¹E. Garfield, "Primordial Concepts, Citation Indexing, and Historio-Bibliography," *Journal of Library History* 2 (1967), 235-249.

²E. Garfield, "Citation Indexing, Historio-Bibliography, and the Sociology of Science," to be published in the Proceedings of the III International Congress of Medical Librarianship, Amsterdam, 1969.

³A. E. Cawkell, "Citations," *New Scientist*, 37 (1968), 483.

⁴A. E. Cawkell, "Search Strategies Using the *Science Citation Index*," In, B. Houghton, Ed., *Computer Based Information Retrieval Systems*, Clive Bingley, Ltd., 1968. Reprinted in *Current Contents—Life Sciences* 12 (November 4, 1969), 90-103.

ARTICLES IN CITATION NETWORK

Historical

A. FARADAY M.

In "Bakerian lecture" (Royal Society 12th January 1832) and in "Experimental researches in electricity," a book embodying 1831-1852 PHIL. TRANS. papers.

(Faraday measured the flow of the Thames at Waterloo Bridge with an instrument embodying the principles of modern electromagnetic flowmeter. This experiment was repeated by YOUNT et al. in 1920 and described in—YOUNT, GERARD and JEVONS PHIL. MAG. 1920 60 148.

"On electrical disturbances due to tides and waves").

B. SMITH, C. G. and SLEPIAN, J.

U. S. Pat. 1249590, 1917

"Electromagnetic ship's log."

C. WILLIAMS, E.

PROC. PHYS. SOC. 42 466 1930

"The induction of e.m.f.'s in a moving liquid by a magnetic field, and its applications to an investigation of the flow of liquids."

Milestone

F. KOLIN, A.

PROC. SOC. EXP. BIOL. MED. 55 53 1956

"Electromagnetic flowmeter. Principles of method and its application to blood flow measurements."

H. SHERCLIFF, J. A.

Cambridge University Press, 1962.

"The theory of electromagnetic flow measurements."

I. WYATT, D. G.

PHYS. MED. BIOL. 5 289 1961

"Problems in the measurement of blood flow by magnetic induction."

Edifying

D. WETTERER, E.

Z.f. BIOL. 98 26 1937

"A new method for measuring the rate of blood circulation in an unopened vessel."

E. KOLIN, A.

ANN. PHYSIOL. PHYSIOCHEM. 15 1022 1957.

G. KOLIN A., KADO R. T.

PROC. NAT. ACAD. SCI. 45 1312 1959

"Miniaturisation of the electromagnetic blood flowmeter, and its use for recording of circulating responses of conscious animals to sensory stimuli."

J. SPENCER, M. P., DENISON, A. B.

IRE TRANS. MED. ELEC. ME-6 220 1959.

"The square-wave electromagnetic flowmeter; Theory of operations and design of magnetic probes for clinical and experimental applications."

K. DENISON, A. B., SPENCER, M. P., GREEN, H. D.

CIRC. RES. 3 99 1955

"A square wave electromagnetic flowmeter for applications to intact blood vessels."

L. BECK, H.

AM. J. MED. ELEC. 4 87 1965

"Calibration characteristics of pulsed field magnetic flowmeters."

M. HOGNESTAD, H.

MED. RES. ENG. 5 28 1966

"Square-wave electromagnetic flowmeter with improved baseline stability."

N. FRANKLIN, D. L.

MED. ELEC. BIOL. ENG. 3 27 1965

"Technique for measurement of blood flow through intact vessels."

O. KOLIN, A.

CIRC. RES. 21 889 1967

"An electromagnetic catheter flowmeter."

P. KOLIN A.

P. NAS U.S. 57 1331 1967

"An electromagnetic intravascular blood flow sensor."

Q. MILLS, C. J.

PHYS. MED. BIOL. 12 409 1967

"A catheter tip electromagnetic velocity probe for use in man."

R. KOLIN A., ROSS, C., GROLIMAN, J. H., ARCHER, J.

P. NAS U.S. 59 808 1968

"An electromagnetic catheter flow meter for determination of blood flow in major arteries."

S. BAKER, R. C.

J. FLUID MEC 33 73 1968.

"On potential distribution resulting from flow across a magnetic field projecting from a plane wall."

T. BAKER, R. C.

J. PHYS. D. 1 895 1968

"Solutions of electromagnetic flowmeter equations for cylindrical geometrics."

U. LAURIDSE, P.

DAN. MED. B. 15 193 1968

"Blood flow measurements by means of an electromagnetic flowmeter during operations for coarctation of aorta."

V. WIEGAND, D. E.

IEEE NUCL. SC. NS 15 28 1968

"Summary of an analysis of eddy-current flowmeters."

W. ROBINSON, D. A.

PIEEE 56 1065 1968

"Electrical properties of metal micro-electrodes."

X. RENWICK, S., GABE, I. T., SHILLINGFORD, J. P., MARTIN, P.

SURGERY 64 544 1968

"Blood flow after reconstructive arterial surgery measured by implanted electromagnetic flow probes."

Y. GILLIS, M. F., PETERSON, P. L., KARAGIAN, M. T.

NATURE 217 965 1968

"In vivo detection of circulating gas emboli associated with decompression sickness using doppler flowmeter."

Z. BENCHIMO, A., MAIA, I. G., GARTLAN, J. L., FRANKLIN, D.

AM. J. CARD. 22 75 1968

"Telemetry of arterial flow in man with a doppler ultrasonic flowmeter."