

BOOKS, COMPUTERS AND MEDICINE

(Contributions of a friend of Sir William Osler)*

by

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ON this occasion, the 116th anniversary of Sir William Osler's birth, one is tempted to recount again the many significant contributions of this versatile physician, teacher, historian and bibliophile. However, I have chosen to discuss the accomplishments of his friend, Dr. John Shaw Billings, the first Librarian of the National Library of Medicine and to trace their relationship to books, computers and medicine. We are celebrating the centennial of Dr. Billings' appointment this year.

These two accomplished and distinguished men were close friends and admirers. There are a number of references of one to the other scattered throughout the medical literature. One of the most inspiring of these was Osler's address at the convocation memorializing Billings' death.¹ 'I speak of Dr. Billings with the reverence inspired by a friendship of nearly thirty years, and I bring officially the appreciative recognition of his great work of the Bibliographical Society of Great Britain of which he was a much esteemed honorary member and of which I happen to be President'. Osler referred to Billings' work as a bibliographer and compared him to such great students of medical literature as Conrad Gesner, Haller, Ploucquet, Haeser, Young, Eloy, Boyle, Forbes and Watt. He concluded, however, ' . . . their labors are Lilliputian in comparison with the Gargantuan undertaking which occupied the spare moments in some thirty years of Dr. Billings' life.'

Harvey Cushing remarked that ' . . . Osler and Billings had many common tastes and interests which had drawn them together'.² In common too were circumstances relating to their birth and early youth. Both were born of English ancestry in sparsely settled regions of their respective sister countries; Osler at Bond Head, Ontario, and Billings some 300 miles away and eleven years earlier (1838) in Cotton Township, Switzerland County, Indiana. Both would, one day, play major roles in the same capital cities of the Eastern Seaboard. However, the path of Billings was the more troubled. After graduating from Miami University, Oxford, Ohio, in 1857 he entered the Medical College of Ohio (founded, incidentally, as the second Medical School west of the Alleghenies by Daniel Drake). There he spent two years of privation, graduating in 1860. Billings was then appointed demonstrator of anatomy at the college. But the War between the States soon divided the Nation and he spent the next three years as an Army Surgeon. His notebook and letters³ tell of his activities

* The Osler Oration, presented before the Osler Club of London at the Royal College of Physicians, London, 12 July 1965.

Books, Computers and Medicine

in major battles of that conflict: Chancellorsville, Gettysburg, Wilderness, or 'Somewhere in Virginia.'

Though the war had put an end to Billings' academic career, it thrust upon him another. In 1864 he was assigned to the Office of the Surgeon General of the Army in Washington and in the fall of 1865⁴ was appointed in charge of the Library of that Office, soon to be located in Ford's Theatre, the scene of the assassination of Abraham Lincoln. This was the post that was to lead to friendship with Sir William and other great men of medicine of their time.

A keen reflection of their mutuality of interests and experiences is found in a few unpublished letters from Sir William to Dr. Billings.⁵ These letters show how books, technical inventions and clinical medicine brought these men together at the close of the last century. Paramount among these interests was a love of books and the development of libraries.

The scholarly and perceptive Dr. Osler had begun to exchange books and manuscripts with the National Medical Library as far back as 1883 when he was at McGill. He had discovered the enormous value of the *Index Catalogue* and the *Index Medicus* and was its champion wherever he went. The following letter addressed to Billings' associate, Dr. Fletcher, is characteristic of his attempts to acquire copies of these works for libraries throughout the world:

Norfolk and Norwich
Medical Chirurgical Society
Norwich
Sept. 1st, 1903

Dear Dr. Fletcher:

I was sorry not to see in the excellent Library the *Index Catalogue*. Could it not be sent here? There is a collection of about 5,000 books and the young men use it very much. The Librarian, Mr. Quinton, is a man after your own heart.

Sincerely yours,
Wm. Osler

I sail on the 16th. Hope you are very well.

Osler used the Surgeon General's Library extensively. His wit and great respect for the value of books is reflected in a delightful note which he sent to Dr. Billings inviting punishment for losing one of our library books (probably left on the train between Washington and Baltimore).

Feb. 18, 1890
209 W. Monument Street

Dear Dr. Billings:

Bring a club with you on your next visit & pummel me well. What an aggravating devil I am! Yes do order the book and make me pay double for it if possible.

Sincerely yours,
Wm. Osler

Osler's high regard for Billings is clearly evident in the form of two letters inviting Billings to take charge of the Bodleian Library.

Martin M. Cummings

13, Norham Gardens,
Oxford
Nov. 10th, 10. [i.e., 1910]

Dear Billings,

Do you happen to have a spare copy of your pamphlet on *Medical Education. Extracts from Lectures before the Johns Hopkins University, 1877-78?* A commission is trying to reorganize education in London; one great difficulty is in connection with medical education. I am to give evidence, and I would like to borrow some of your powder. You will be sorry to hear that that unique character, Bodley's Librarian, is very seriously ill. I wish you could take hold of the place for a year, with Mr. Carnegie's purse behind you. We have our under-ground stack completed, which will hold more than a million volumes. Sorry to have missed you this summer.

Sincerely yours,
Wm. Osler

My Dear Osler,

Your note of November 10th is received. I am sorry to say that I have not any copy of the pamphlet on "Medical education," to which you refer. It is possible you may find one in the library of the Royal Medical and Chirurgical Society. Very few copies were printed off, only about enough for the use of the Trustees.

I am sorry to hear of the illness of Mr. Nicholson. It would never do to have a man like myself in his place. With best wishes,

Yours very sincerely,
J. S. Billings

Doctor William Osler,
Regius Professor of Medicine
13, Norham Gardens, Oxford

Osler was not alone in his appreciation of Billings' development of the *Index Catalogue*. Not long before his last illness, Dr. William Henry Welch (1850-1934) paid a visit to the Library of the Surgeon General's Office, as it was known prior to 1928. He was one of the Library's oldest friends and most constant users. As he sat in the Librarian's (Col. Edgar Erskine Hume) office smoking one of his black cigars, he fell into one of those reminiscent moods which his friends and pupils so enjoyed. He spoke of the foundation of the Library, of its growth, of the place it occupied in the world of science, and then said: 'I have been asked on more than one occasion what have been the really great contributions of this country to medical knowledge. I have given the subject some thought and think that four should be named: (1) The discovery of anaesthesia. (2) The discovery of insect transmission of disease. (3) The development of the modern public health laboratory, in all that the term implies. (4) The Army Medical Library and its Index Catalogue. And (he added slowly) this library and its catalogue are the most important of the four.'⁶

The 'ghost' of Billings pervades the atmosphere of the National Library of Medicine in Bethesda, Maryland; indeed, so do the shades of Osler, Oliver Wendell Holmes, William Welch, and many others who recognized and encouraged both the scholarly and pragmatic innovations which Billings undertook in our library at that period of history (1865-1895). Although Billings will be remembered primarily for his development of the *Index Catalogue* and *Index Medicus*, he made several lesser known innovations and contributions which I believe deserve further elaboration.

Many have forgotten that it was Dr. John Shaw Billings who designed the Johns Hopkins Hospital and the curriculum for the medical school. It was he also who went to Philadelphia where in less than several minutes he recruited Dr. Osler to become

the first Professor of Medicine at Johns Hopkins. Osler's own account of this event clearly reflects the characters of these two men of action. 'An important interview I had with him illustrates the man and his methods. Early in the spring of 1889 he came to my rooms, Walnut Street, Philadelphia. We had heard a great deal about the Johns Hopkins Hospital, and knowing that he was virtually in charge, it at once flashed across my mind that he had come in connection with it. Without sitting down, he asked me abruptly, "Will you take charge of the Medical Department of the Johns Hopkins Hospital?" Without a moment's hesitation I answered, "Yes". "See Welch about the details; we are to open very soon. I am very busy today, good-morning", and he was off, having been in my room not more than a couple of minutes.'

Dr. William Welch, the first Professor of Pathology at Johns Hopkins had already been recruited by Billings in 1884. After Billings' death in 1913, Welch described the role which Billings played in the development of Johns Hopkins as follows:

Dr. Billings was one of the five eminent physicians selected by the Trustees to prepare essays regarding the best plans to be adopted in the construction and organization of the hospital for which Johns Hopkins had provided the largest gift of money which had been made up to that time for such a purpose. His essay was chosen as the best, and from 1876 to the opening of the hospital in 1889 he acted as the highly efficient medical advisor of the Trustees of the Johns Hopkins Hospital, whose confidence he enjoyed in the highest degree.

The building of the Johns Hopkins Hospital, with its admirable arrangement for heating, ventilation, isolation, sanitary cleanliness and nursing, and especially those 'for joining hands with the University,' as Dr. Billings expressed it, in the work of medical education and discovery, marked a new era in hospital construction, for which Dr. Billings deserves the chief credit.⁸

I find it necessary to point out, however, that Cushing noted that Billings made only 'scant provision' for a medical library at Hopkins.⁹

Perhaps even less well known are the contributions made by Billings to the field of vital statistics and to the technology of electric data processing. The origin of vital statistics is recognized as an English contribution. The first Bills of Mortality were prepared in 1532 and were issued from time to time until 1849, but received little attention—not even from Sydenham, until 1662 when John Graunt published his slender volume *Natural and Political Observations . . . Upon the Bills of Mortality*. In his book Graunt extrapolated mortality and morbidity data for various diseases in different districts of London. This modest author remarked of his own work ' . . . there is much pleasure in deducing so many abstruse, and unexpected inferences out of these poor despised Bills of Mortality; and in building upon that ground, which has lain waste these eighty years. And there is pleasure in doing something new, though never so little, without pestering the world with voluminous transcriptions.'¹⁰

When the observations of Graunt and his successors were finally put to use for the improved practice of public health and clinical medicine the need for an accurate and efficient device to handle masses of data became apparent.

Although Joseph Marie Jacquard in 1780 invented a machine in which perforated cards controlled the pattern of hooks and needles for use in weaving and the English mathematician, Charles Babbage, later (1828) tried to develop an 'analytical engine', it was clearly Hollerith and Billings who developed the first operational device using perforated cards for statistical purposes.

The invention of the electrical tabulating machine using punched cards is properly attributed to Herman Hollerith, a statistician, who was working at that time for the United States Census Office. From his own account and that of others, it is clear, however, that it was Dr. John Shaw Billings who, serving as consultant to the Census Office, first suggested to Hollerith that an electrical machine utilizing punch cards should be developed for use in the 1880 census. The evidence for this has been recently reviewed by Love, Hamilton and Hellman in their publication, *Tabulating Equipment and Army Medical Statistics*.¹¹

Billings himself wrote in 1891 'That the data collected by the census for each living person, or, in systems of death registration, for each decedent, might be recorded on a single card or slip by punching small holes in different parts of it, and these cards might then be assorted and counted by mechanical means according to any selected grouping of these perforations, was first suggested by Billings in 1880'.¹²

Finally, we have Hollerith's own statement, 'While engaged in the 10th census, that of 1880, my attention was called by Dr. Billings to the need of some mechanical device for facilitating the compilation of population and similar statistics. This led me to a consideration of the problems involved'.¹³

Billings gave a brief description of the electric tabulator which reads in part:

The cards thus punched are passed through machines in which an electrical connection is made by the passage of a metal rod through the cards wherever a hole has been punched, and the currents thus produced actuate a series of small dials on which the number of the data is recorded . . . The machine not only records certain groups of facts on the dials, but has series of assorting boxes which also have electrical connections by means of which the cards, as they pass through the machine, can be assorted into groups on any system required, as, for instance, into groups of ages, into groups of birth-place, or according to birth-place of mother, or according to occupations, etc.¹⁴

This electrical tabulating machine, the forerunner of the modern computer, was actually used in connection with the 1886 mortality records of the city of Baltimore. It was used also in the Surgeon General's office for compiling and tabulating Army health statistics in 1889. It handled massive amounts of data collected in the United States Census of 1890. This tabulator made it possible to complete the population count of the United States in only six weeks, a task which previously had taken more than a year when hand methods were employed.

A more comprehensive account of the machine is given in the publication of General Love and others cited above. It is of interest to note that Hollerith first used tape (presumably paper tape) before adopting the suggestion of Billings to use punched cards.¹⁵

Osler was among the first to utilize machine-compiled vital statistics for application to medical research, teaching and practice. The following two letters show his eagerness to acquire data obtained by the 1890 Census for these purposes.

1502 Walnut Street
Phila.
Sept. 6th

Dear Dr. Billings:

Sorry to trouble but I would like to know whether you think the pneumonia statistics of the last census reliable enough to draw the conclusion which they warrant, that the mortality in this disease was enormously increased.

Yours sincerely,
Wm. Osler

Books, Computers and Medicine

Baltimore, July 20th, 1891

Dear Dr. Billings:

Sorry to worry a busy man, but I would like very much to know when the vital statistics of the census of 1890 will be available. I wish particularly to refer to such questions as tuberculosis among the Indians.

u. s. w.

Very sincerely yours,
Wm. Osler

P.S. I suppose it would be possible if I send some one over to get the cards on trichiniasis. I want to make a reference to the number of epidemics which have occurred in this country and the number of cases.

One might say that Osler at this time modified his precept from 'From books to bedside and back to books again' to 'From computers to bedside and back to computers again.'

Although some consider Alexander the Great as the first formal patron of research for the large sums of money and resources he made available to Aristotle for specimen collections and taxonomic research, in our country, at least, it was Dr. Billings who was responsible for the first federal grants made in support of medical research in 1880. While Librarian of the Surgeon General's Office he also served as Vice President of the National Board of Health, a short-lived predecessor of the U.S. Public Health Service. He justified the use of federally appropriated funds for support of special scientific investigations, which in itself is noteworthy. But more important he and his associates made a remarkable choice of subjects to be studied since many of these same problems remain important areas for study today. These are reported in the *Annual Report of the National Board of Health*, for the year 1880.¹⁶ Among the research grants awarded were the following:

1. The collection of information and advice from the principal sanitary organizations and sanitarians of the United States as to the best plans for a national public health organization.
2. The investigation of yellow fever in the island of Cuba by a commission of experts consisting of Dr. G. M. Sternberg, U.S.A. and others.
3. An investigation as to the best method of determining the amount and character of organic matter in the air by Prof. Ira Remsen, of Johns Hopkins University.
4. An investigation as to the effects of disinfecting agents upon the causes of the infectious diseases by Dr. C. F. Folsom, Dr. W. S. Bigelow, of Boston, Dr. H. P. Bowditch, professor of physiology, and Dr. Wood, professor of chemistry, in Harvard University.
5. An investigation into the adulterations of food in the United States, by Prof. R. M. Kedzie, M.D., president of the State board of health of Michigan, and by Prof. Lewis Diehl, of Louisville, Ky., as to the adulterations of drugs.
6. An investigation by Prof. J. W. Mallet, of the University of Virginia, on the best method of determining the amount of organic matter in potable water, and its effect on the health of persons who drink such water.

Thus Billings, the librarian, medical bibliographer, and hospital designer may also be considered to have been one of our nation's foremost medical statisticians and science administrators. He was also the engineering consultant who designed the

Martin M. Cummings

ventilation system for our nation's capitol, the designer and librarian of the New York Public Library system, a feat which he accomplished by charming five million dollars from Andrew Carnegie.

Here then are a few vignettes of a friend of Sir William Osler which reinforce the ideas and views that books, computers and medicine may be used together to improve and advance the state of man's health.

Today, the NLM uses modern high-speed electronic computers for the organization and publication of the *Index Medicus* and for the storage and retrieval of citations to the world's biomedical literature. Thousands of physicians now request information as did Sir William Osler seventy-five years ago. We are planning to extend the power and scope of this automated reference retrieval system to the medical community of the United Kingdom in the same way I am sure that Billings and Osler would have implemented this in their time.

Computers are being applied also to manage laboratory and clinical records of hospitals and clinics. They are used for rapid evaluation of electrocardiograms and other physiological measurements. They will undoubtedly be used for many other logical functions in teaching, research and the practice of medicine.

The suggested use of digital computers as a diagnostic aid for clinical practice sends a shiver through the spine of many clinicians. If we remember that this instrument cannot yet take a history, perform a physical examination or administer therapy (especially psychotherapy) then we have little to fear with regard to its intrusion into medicine. On the other hand, it has a flawless memory and, given appropriate information, it may be used to extend the skills of physicians by providing statistical probabilities with respect to differential diagnosis, and particularly in organizing masses of data which can be processed quickly and returned to the physician for final evaluation and judgment.

I look forward to the continued use of books and computers as an aid to man's memory and as an adjunct to his skills and talents. Let us not, however, fragment the unity of medicine by attempting to exploit these new modalities of information and communication technology without considering their effects upon the welfare of people, individually and collectively, and upon the purposes which medical teaching, research and practice are dedicated. Osler and Billings were men who knew how to combine the past with the present, and concern themselves with the frailties of humanity. Unless their perspectives are retained, the art of medicine may become a cool unfeeling science, much to the discomfort of the patient and the practitioner.

'An institution is the lengthened shadow of one man,' Ralph Waldo Emerson observed more than a century ago. Osler's friend, John Shaw Billings, cast shadows over many institutions, as did Osler himself. I am grateful to you for having given me this privilege and opportunity to rekindle some of the oblique light from which these shadows were originally cast.

[At the end of his speech, Dr. Cummings, on behalf of the National Library of Medicine, generously presented several of the letters cited in his talk to the Osler Club of London. The President, Dr. Charles Newman, thanked Dr. Cummings warmly for this valuable gift, which would take its place in the Club's already substantial collection of Osleriana.]

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5. The Osler-Billings letters cited are from the collections of the National Library of Medicine or the New York Public Library.
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