The chief architectural bequest of the Renaissance was its domes, represented by an analysis of S. Maria del Fiore at Florence, first and most famous of them. He gives less of the actual history of their construction than he had for the bridges and what there is seems to be based on secondary sources, whereas he had examined and often quotes at length from primary material in the archives relating to most of the bridges. Perhaps this chapter should be regarded as an outline only, to which he had hoped to add much more. The next chapter, on Saint Peter's at Rome, ends abruptly after a sketchy start, just when Michelangelo has arrived on the scene. Given that this was the state in which Parsons left the book at his death, there can be no question of complaint. Rather we should be thankful that we have so much.

Engineers and Engineering has become a classic in the history of early technology, so that the reprinting deserves even this belated review. Nowadays historians appreciate that the economic growth, and indeed the art and architecture of the Renaissance cannot be understood without knowing something of its engineering and the problems it faced, while technologists are ready to believe that there might have been great men before James Watt. So this time around, let us hope it will become a classic that is bought and read.

ALEX KELLER*

Invention of the Meteorological Instruments. By W. E. Knowles Middleton. Baltimore: John Hopkins Press, 1969. Pp. 362; illustrations. $12.00.

The book, as the name indicates, discusses the inventions and developments of the major instruments used for meteorological observations. Each of the first ten chapters deals with a specific instrument or a group of related devices. The eleventh and the last chapter, the Epilogue, is a very brief two-page summary of the chronology of the development of instruments and their applications and is followed by an index.

The first two chapters on the barometer and the thermometer are the abridged versions of Middleton's earlier and more extensive works—*The History of the Barometer* and *A History of the Thermometer and Its Uses in Meteorology*. This, however, is understandable, since no history of meteorological instruments can ever be complete without dealing with these two major instruments. The next eight chapters deal with instruments for measuring humidity, rain gauge and the atmometer, windvane and the anemometer, measurement of the duration of sunshine, early meteorographs, upper winds and the height and motion of clouds, upper-air soundings without telemetry, and telemeteorography and the radiosonde.

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It is difficult to agree with Middleton's statement that "meteorology as a science can hardly be said to have existed before the invention of the barometer and thermometer." This means that meteorology as a science started only in the 17th century. Admittedly, the first meteorologic principles were extremely crude, but we have to realize that all sciences have developed from very modest beginnings. The author implies that one cannot treat a branch of science as such until a certain degree of development and sophistication has taken place (the invention of barometers and thermometers in this case), but who will define that universally acceptable degree and how will it be measured? To paraphrase the great historian of science, George Sarton, a 2-inch high *Sequoia Gigantes* may not be very conspicuous, but it is still a *Sequoia.* After all, when the first primitive mathematician realized that there was something similar in three palm trees and three donkeys, how abstract was his thought? A pertinent example in the context of the present review will be Hippocrates' experiment on evaporation which, incidentally, does deserve a mention in this comprehensive treatise. (See, for example, Asit K. Biswas, "Experiments on Atmospheric Evaporation until the End of the Eighteenth Century," *Technology and Culture* 10 [January 1969]: 49–58; and Asit K. Biswas, *History of Hydrology* [Amsterdam, 1970].) This qualitative experiment of Hippocrates, in the opinion of the writer, is a milestone in the field of meteorological observations, and such developments were instrumental in the continual early progress of all sciences.

The chapter on the rain gauge and the atmometer needs some correction. The earliest reference to a rain gauge, as the author states, was made by a very resourceful chancellor of exchequer of India, Kautilya (also known as Vishnugupta Chanakya), who decided to tax agricultural lands according to the rainfall they received. He suggests that the Indians of this period (4th century B.C.) did not consider expressing rainfall as a depth of water. This is erroneous, as Kautilya in his book on *Arthasastra* said: "In [front of] the store house, a bowl with its mouth as wide as an *aratni* [18 inches] shall be set up as a rain-gauge." From this it can be inferred that the Indians tended to use standard-size rain gauges, and the rainfalls were expressed as depths in inches of water. (For further details, refer to Asit K. Biswas, "Development of Rain Gages," American Society of Civil Engineers, *Journal of the Irrigation and Drainage Division* 93 [September 1967]: 99–124.) Incidentally, the author refers to Kautilya's book as *Arthastra.* It is *Arthasastra;* the Sanskrit meaning is completely changed by *Arthastra.*

One of the major developments in rain gauges, not mentioned by the author, occurred in China in the 13th century. The Korean rain gauges, mentioned by Middleton, like other Korean astronomical instruments, were actually copied from the Chinese. For example, the book *Shu Shu Chiu Chang* [Mathematical treatise in nine sections] by Chin Chiu-Shao, which dates back to A.D. 1247, has a series of problems

concerning the shaped rain gauges, called *thien chhih tsĥe yü.* They were conical or barrel-shaped vessels and were installed at all provincial and district capitals. The book also deals with snow gauges made of bamboo that were placed at the sides of mountain passes and uplands. This is probably the first use of snow gauges on record. Of interest to meteorologists is Chiu-Shao's method of determining the amount of rainfall over an area from observations of point rainfalls.

The book contains some amusing observations of past inventors. For example, in the chapter on instruments to measure humidity, Middleton quotes the case of David Wilson of Dublin who used the urinary bladder of a rat as the sensing vessel of a hygrometer. Many such hygrometers were made, and during the process of their manufacture, the inventor provided the startling observation that London rats are "very subject to urinary calculi, which I do not find to be the case in other towns." Middleton, however, does concede that this may be the result of the rat race!

Middleton's conclusion in the penultimate chapter on telemeteorography and the radiosonde is worth quoting: "It is fitting to recall the pioneers of the 1920's and 1930's, who laid the foundation of the subsequent edifice, on budgets that would not support the canteen of a present day establishment."

The book, like Middleton's earlier works on meteorological instruments, is a scholarly one and is excellently produced. It is beautifully illustrated with some 224 figures ranging from line diagrams to lovely woodcuts and engravings. The book ends with World War II, and it is a fitting time to end since it is extremely difficult to review contemporary developments dispassionately and objectively. It should be of considerable interest to all meteorologists and historians of science and technology.

ASIT K. BISWAS*

A View of Early Typography. By Harry Carter. Oxford: Clarendon Press, 1969. Pp. 137; illustrations. $5.95.

The James P. R. Lyell Lectures at Oxford are given annually on the subject of bibliography, which is understood to mean the history and description of books. This book contains the five Lyell Lectures for 1968 by Harry Carter.

The study of typography is already familiar to bibliographers, particularly incunabulists, as a useful tool for identifying imprints, and they have done some admirable work on the early printing types. Carter's object is to persuade bibliographers to take typography in a wider sense than they have in the past. The bibliographer's real interest

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