

to 20 quills suitable for writing). In order to produce a pen from a goosequill, it was necessary to clean it from coating, to dry it by a specific means, to increase its durability with the help of special compounds, and then to dry it again. Of course, some losses accompanied this technological process. By the middle of the 19th century, the number of people who could read and write was in the millions, and extrapolation of the almost exponential growth of literacy into the near future showed that a significant fraction of adults of the population would be occupied either with raising geese or with production of quill pens.

In 1780 the Englishman Harrison invented the steel pen. Of course, at the beginning it cost more than several geese, but after 70 to 80 years it practically displaced quill pens. Thus, a crisis situation produced by a type of instrument that was no longer able to provide the growing information needs of society was overcome. (As a reminder of how times have changed, the first version of this book—the manuscript—was obtained with the help of the laser printer!)

The examples of different information crises described in this chapter lead to the following conclusion: *Historically, information crises have arisen when available means, methods, or forms used in information activity could not manage the existing flow of information for satisfaction of the IN.* Therefore it is valid to talk about a crisis of means, a crisis of methods, or a crisis of forms at a particular time period.

It is clear that any means, methods, or forms, including those used in information activity, are finite. The life span of some is millennia, of others centuries, and still others prove to be one-day butterflies. It is obvious that these means, methods, and forms do not die off immediately or in one day, and sometimes for specific conditions and tasks they are preserved for a long time. For example, in spite of modern publishing technology, even today the Torah is copied only by hand; or in spite of the invention of paper, even today we see modern "graffiti" on rock faces. Of course, each of the means, methods, and forms was an element of progress in the history of humankind, which by dying away gave place to more modern counterparts that would correspond to users of their time. Thus, historically from method to method, from form to form, information activity developed. From this point of view, we will consider the modern information situation.

3.3

The Modern Information Crisis

In the first half of the 20th century, unprecedented growth of scientific activity took place. We will discuss only some indicators characterizing this growth. For example, according to UNESCO data (1973), in 1800 there were 1000 scientists in the whole world; in 1850 they already numbered 10,000; in 1900 there were 100,000; in 1950 there were 1 million; and by 1970 their num-

ber reached 3.2 million people. When the number of people occupied with scientific investigations reached 2 million people (approximately in 1960), it was estimated that more than 90% of investigators working in all epochs of human history were our contemporaries (Auger, 1963).

Because the unique responsibility of the scientist is obtaining new information, and the form of accounting is publishing this information, then it is not difficult to imagine how the flow of information circulating within the framework of information activity has increased. In 1910 approximately 13,000 journal articles and books on chemistry and chemical technology were published in the world, and 1900 books on physics were published, in 1975 these numbers were respectively 413,000 (an increase of almost 32 times) and 85,000 (an increase of almost 45 times) (Michailov, Cherny, & Gilarevski, 1976). The number of periodical scientific publications also grew continuously. In 1900 fewer than 10,000 titles of scientific-technical journals were issued, by 1980 their number exceeded 50,000. It is estimated that more than 4 million such articles are published in the world annually.

Some of the first people to perceive the negative effects of the great growth in the amount of available information turned out to be exactly those who produced this information—scientific workers. Robert Oppenheimer (one of the leading American physicists, who directed the development of the first atomic bomb) pessimistically noted that "we need new knowledge like a hole in the head" (Price, 1961). And this is how French physicist (Nobel laureate) Louis de Broglie characterizes the state of the investigator faced with the ever-increasing flow of information: "The scientific worker often feels buried under the mass of articles and monographs being issued in all corners of the globe. . . . Sinking in a never ending stream of publications, he is always risking overlooking what is the main thing" (De Broglie, 1962). "It is not ruled out that many interesting results get lost in a heap of insignificant accounts not subjected to reading," warned Norbert Wiener (1954). It is not difficult to compile a list of similar sayings, but one should not think that they are peculiar to just the 20th century.

In practically all epochs, scientists have not ceased to complain about the abundance of information. This can be confirmed by the following examples. In the library of Assyrian king Ashurbanipal (during the middle of the 7th century B.C.), there were more than 30,000 cuneiform tablets on all branches of knowledge of that time (Johnson, 1965). Historians say that by 47 B.C. the holdings of the famous Alexandrian library contained about 700,000 scrolls. Describing the unusually rapid growth of holdings at the Alexandrian library, the prominent Swiss Hellenist Andre Bonnard wrote:

The library grew not only due to the purchase of classical works, but also due to the exceptional fruitfulness of authors of that time. One philologist, named Didymus, put together three thousand five hundred scrolls of commentary. If even then an over-extensive work usually consisted of several scrolls, then nevertheless a similar abundance seems rather formidable. The names of more than one thousand one hun-