Our Diminishing Water Supply

EDWARD E. KESO, Oklahoma A. and M. College, Stillwater

Water is necessary for the existence of man. Some of its outstanding uses are for human and animal consumption, for industry, for household use, as a home for fish and aquatic life, for recreational uses, for all plant life, as a means of transportation, for the disposal and removal of industrial waste, for the generation of water power and electricity, for refrigeration and air conditioning, and for fire protection.

Water moves in an endless cycle from the atmosphere to the land or ocean and back again. This cycle, however, is interrupted by the storage of the water in plant life, in natural or artificial lakes, in the soil, or in the porous rocks or cavities of the earth.

Water supplies, are called water supplies when they are taken from streams, lakes or reservoirs, and ground supplies when taken from wells or springs (4). A water supply may be assumed to be sufficient when it fully supplies the needs of man, and to be insufficient when the demand exceeds the available supply.

We can still safely assume that there is sufficient water on the earth to meet the demands of man. However, water is unequally distributed throughout the world, and even though rainfall on a given area, when figured over a long period of years may not vary much, when considered over short periods of time, we may have devastating floods at one time with serious drouths in the same area later. When shortages occur it is not necessarily the fault of nature but rather the lack of foresight and bad usage of this valuable resource by man.

The history of settlement of people in various parts of the earth is very similar in that they settled near or along the coasts of lakes, oceans, or streams near the source of a water supply. As the population increased people moved inland and built their homes near oases, lakes, or springs. With continued population pressure they spread out over the less watered and less desirable plains, or plateaus, and survived on the water that had accumulated over a long period of time. When their flocks overgrazed the area and water run off faster than before, local streams and natural reservoirs dried up and man had to resort to digging wells and cisterns in order to exist a few years longer on nature's accumulated supply. When a drouth struck the area man either had to migrate or die.

The migrations of people from southern Russia westward to Europe is good evidence of what happened in that area thousands of years ago. The story of Persia, with its high type of civilization in the Tigris and Euphrates valleys, is well known. When the Persians failed to properly use their water supply their "Garden of Eden" reverted to desert and now is the home of few people who are practically on a subsistence level. The Northern Sahara region at one time supported many times its present population and exported grain to Europe and Asia. So great was its prosperity that it drew the envy of Rome with the resulting wars which ended with the downfall of Hannibal. When the Romans exploited this area and failed to take care of the resources, chief of which was water, this area too soon became a desert and has so remained until the present time.

There are many references in the Bible to water, or lack of a water supply. As the water supply diminished and people and animals suffered, the inclusion of reverence for water in ceremonies of religions in many countries including Egypt, Persia, India, China, Greece, Mexico, and Peru became popular. Wells have been worshiped in some places, and springs, or "living waters" as they were sometimes called were especially cherished

(3). Even in the United States prayer service for rain has been held in many churches in recent years.

Evidence of man's attempt to regulate the water supply by building retaining reservoirs has been found in the foothills of South Arabia, and on the upper Euphrates and Tigris rivers. Lake Moeris on the upper Nile, which was described by ancient writers as being a great reservoir for regulating the Nile floods, was supposed to have been constructed about 2300 B. C. Herodotus (430 B. C.) describes it as receiving water from the Nile during the floods and sending it back when the river was low. Strabo (20 B. C.) stated that there were regulators at both ends for controlling the inflow and outflow (6). The irrigation system devised by the Egyptians, whereby canals were dug in the earth leading from the sides of the Nile, not only served for irrigation of the land but served for storage of surface water and raising the level of the nearby underground water level.

Today nearly everywhere on the African Continent the watertable appears to be continually sinking as a result of increased runoff and evaporation. During 1936-39 the Government of South Africa subsidized the boring of 2,070 wells (6). The headwaters of the Nile, on which the entire economy of Egypt depends, are threatened by deforestation and siltation near their sources. The level of lakes in Uganda is steadily falling (8).

In southern Europe, as the population increased many types of wells were dug and aquaducts were constructed. As the ground water table was lowered, wells were dug deeper and storage reservoirs were provided. The slopes around the base of the hills are pitted with wells of various dates. As many of these no longer have water or have filled with debris, even though many may have been ruined because of the neglect of man, we can safely assume that if water was available they would be reopened again. France, too, has difficulty in supplying sufficient water for its people, while England, probably one of the best watered countries in the world, has a problem of supplying enough water for its people and industry. In London, where the water table has been sinking for some time, one city chairman in explaining to his shareholders about the high cost of water, said that at prevailing rates, it might be cheaper to use claret for every purpose for which water was used in that city building (6).

In the United States the first settlers located near the coast or along streams or lakes where the water was plentiful. As they moved westward they followed the streams or if they moved inland they built their houses near a good spring. As population increased, the better land and most favored areas were quickly taken, and people moved into the hilly, forested areas or on the marginal lands of the midwest or west. They soon deforested the hills, or overgrazed the plains. When more land was needed they drained the swamps and straightened the streams so that the water would move away faster. They used up most of the humus supply in the soil with the result that the soil became so packed that its water holding capacity was greatly reduced and the water that fell upon the soil flowed away, carrying away top soil and adding to the flood hazard. People then began to complain about floods and drouths.

In many ways those two problems though entirely different, have much in common. Water that causes the flood is lost while, if it could be conserved, it would do much toward solving the water problem during periods of need.

With the fast growth of industry and its great use of water, many areas have reached their capacity or are actually suffering from a shortage of water. To produce a gallon of alcohol requires 100 gallons of water. Grain distilling uses 600 gallons for each pound of mash. One ton of cement takes 750 gallons. One ton of coke uses 3,600 gallons, while a ton

of iron ore uses 1,000 gallons. A ton of dry paper pulp requires from 5,000 to 85,000 gallons. The textile manufacturing industry consumes from 10,000 to 75,000 gallons of water per 1,000 pounds of processed material. In the production of steam power, 100,000 gallons of water per ton of coal burned are needed (1). A paper mill uses about 15,000,000 gallons per day, while cities estimate the use of 125 to 150 gallons per day for each one of their citizens.

With the great growth of population and industry in comparatively small areas, it can easily be seen that even though the water in streams have been diverted for city use, and huge sums have been expended for the building of reservoirs, cities still do not have sufficient water.

Practically the only remaining source has been ground water. Our early settlers built their homes near springs and even small towns or cities depended upon springs as a source of water supply. In large sections of our country every farm had one or more springs for use of livestock. No one took the trouble to count how many springs were in our country. Today it is estimated that from 50-75 per cent of the springs once flowing in settled areas no longer exist. Many of these no doubt were "wet weather" springs that dried up after timber and grass was removed farther up the slope. Others were covered when soil was washed into the valleys. Many more failed when the water table dropped below the level of the spring outlet.

Most of the artesian wells that were proudly displayed fifty years ago no longer exist as flowing wells and one today is rarely found.

It has been estimated that thirty per cent of our cities of 25,000 population or more depend upon ground water for their supply and probably a larger proportion of our smaller cities, towns, and villages. Also it has been estimated that at least 25 per cent of our entire population is supplied entirely or largely from wells. By 1930, the census listed 61,540 wells used for irrigation. Since that time many more have been drilled to secure more and more water for the growth of crops (2).

When more wells are drilled, it means that there is more drain upon the existing supply of ground water, much of which has accumulated in the earth over thousands of years. Is it any wonder then that the water table is gradually falling? It is not a problem of only one state or area. Every state in the United States has reported one or more cases where the water table was being lowered.

As a complete list or reports would fill volumes, only a few are given here as representative of different areas of our country (7).

The great struggle for water in California is perhaps best known of all areas in our country. In the Antelope Valley, 75 miles north of Los Angeles, artesian wells that had flowed 900 gallons per minute had ceased flowing by 1920. In the San Joaquin Valley, water levels are falling at a rate of ten to twenty feet a year and pumping levels are 300-400 feet below ground surface in most of the irrigated area. In the Santa Clara Valley, from 1916-1934 the average water level in wells dropped about 110 feet. In some areas salt water has moved inland more than three miles. The Salinas Valley also reports the encroachment of salt water as the water table is lowered about one-third foot per year.

The Gila River Basin, which includes about half the area of Arizona and more than ninety per cent of the population, industry, and irrigated land, has several places where the water levels have declined more than thirty feet in the last decade. In Deer Valley, eighty large wells were drilled between 1940 and 1948 to irrigate more than 21,000 acres. In the eight years, water levels declined an average of seventy feet throughout the area.

In the Mimbres Valley, New Mexico, where pump irrigation has been extended, the water table lowered more than ten feet from 1942 to 1949; while in the Roswell Basin, artesian pressure dropped so rapidly that new development was practically stopped by 1915. In Cedar Valley, Utah, when irrigation was accelerated the water levels declined ten to fifteen feet between 1932 and 1935, while the Utah Valley, south of Salt Lake City has reached the upper limit of possible development.

Western Texas, too, is developing trouble. In the Salt Flat Basin, in the Dell City area, where wells were drilled for irrigation purposes the water levels in wells declined on the average of one-half foot per year. In the Texas Panhandle, where the number of wells has jumped from 300 to 10,000 since 1934, the water table has dropped more than forty feet (5). Water levels have dropped about 500 feet in the business district of Fort Worth and nearly 300 feet at Dallas. Houston wells have dropped more than seventy feet since 1940.

The Chicago-Milwaukee industrial area, which formerly drew heavily upon ground water supplies has found the artesian pressures declining for the past forty years and is now depending more and more upon the supply from Lake Michigan.

In the Lake Charles, Louisiana rice area, where artesian pressure fifty years ago was sufficient to produce flowing wells, the pressure has declined and the water level is lowered during the period of greatest use. At El Dorado, Arkansas, the water level has dropped more than 170 feet since 1921, while at Memphis, Tennessee, water levels declined fifty feet in the past twenty years. Many other examples can be given.

The State of Oklahoma also has had its share of water shortages. Many can still remember that wells which were deepened in 1934 had to be drilled still deeper in 1936. In Miami a well that had flowed in 1907 was 410 feet below the surface in 1947. During the war the rate of pumping at Norman increased from 2 million to 6 million gallons a day and water levels dropped 130 feet in two years. After the cessation of pumping for war projects water levels in observation wells rose as much as 97 feet, but have since declined slightly, probably because of pumping of nearby wells. Many of the smaller towns have had water shortages during the past few years. Tulsa has temporarily solved its problem, while Enid is reaching out farther to tap ground supplies. Oklahoma City, even with the addition of Lake Hefner, has resorted to the employment of "rain makers" to increase her supply.

In 1949 the industrial northeast had its water famine. New York City, northern New Jersey, and the surrounding territory was the hardest hit. On December 8, 1949, the Governor of New Jersey proclaimed a state of emergency and ordered strict conservation. On December 11, 1949, New York churchgoers were praying for rain (5).

To make the water supply problem still more perplexing we find that industrial waste and sewage poured into many of our streams make the water unfit for use by industry, people, or livestock, thus creating a greater shortage. Salt water and water with a high mineral content also is undesirable. All must then agree that our country is facing a great problem.

It is doubtful if the water problem can be solved in a short period of time or without great cost, however, measures can be taken to prevent it from becoming a catastrophe to our country. Some suggestions are as follows: (a) reuse of water by industry, (b) prevent industries from dumping waste into streams and finding ways of disposing or reclaiming of dangerous acids, (c) more and better sewage disposal plants, (d) relocation of some industries that are great users of water to areas where the supply is still plentiful, (e) prevent further drainage of swamps, where their drainage would lower the water table, (f) restrict further irrigation, especially where the area is dependent upon ground water,

(g) build more terraces to prevent fast runoff of water, (h) build more and larger farm ponds, (i) build multiple reservoirs on our larger streams, (j) the building of great retarding basins to regulate the flow of streams would be helpful, (k) all badly eroded land should be sodded with grass or reforested, (l) crop less land and return it to grass, (m) protect our investment in the reservoirs we already have by returning the drainage area to grass and trees; small cities would be wise to purchase the drainage area of their reservoirs to prevent silt from ruining them, (n) return the humus content to the soil by growing and plowing under legumes, (o) the recharging of wells, (p) along the coasts of the country it may be worthwhile for the cities to have two water systems, one of which might use sea water for sewerage purposes, and (q) teach the people more economical uses of the water that is now available.

Many of the methods suggested would not only save water but would also help to prevent floods. Some may complain that much land would be taken out of cultivation if it would be returned to grass, to forests, or covered by water for ponds, reservoirs or great basins. One thing is certain, we cannot continue using water as we have in the past, and desert land without water produces nothing.

LITERATURE CITED

1. BENARD, FRANK, AND ANTHONY NETBOY. 1950 Water, land, and people. New York: A. Knopf.

2. BENNISON, E. W. 1947. Ground water: its development and conservation. St. Paul, Minn.: Edward E. Johnson Inc.

3. DRAFFIN, JASPER O. 1939. The story of man's quest for water. Champaign, Ill.: The Garrand Press.

4. HOOVER, CHARLES P. 1934. Water supply and treatment. National Lime Assoc. Bull. No. 211.

5. NADEAU, REMI A. 1950. The water seekers. New York: Doubleday Press.

6. ROBINS, F. W. 1946. The story of water supply. London: Oxford University Press.

7. THOMAS, HAROLD E. 1951. The conservation of ground water: A survey of the present ground water situation in the United States. New York: McGraw-Hill.

8. VOGT, WILLIAM. 1948. Road to survival. New York: W. Sloane Associates.