T H E S I S

on

WATER SUPPLIES

Submitted to the Faculty

of the

O R E G O N A G R I C U L T U R A L C O L L E G E

for the degree of

Bachelor of Science

by

Redacted for Privacy

.....

Redacted for Privacy

APPROVED .....

Department of Domestic Science and Art

OUTLINE

Introduction

Sources

Reservoirs

Use

Water as related to disease

Chemical Tests

Bacteriolgy

Water supply of some of the large cities of the world

Bacterial examination of Water

Conclusion

WATER SUPPLIES.

Water is one of the primary wants of human life no less essential than air and food hence the strong and religious interest that has been attached to the means of its supply. In the earliest records of civilization we read of the digging of wells and building of water systems by means of which towns and cities were supplied with their necessary water in a manner similiar to that of today.

These water systems and means of conveyance were not confined to the Eastern Hemisphere but Aseria, Persia, Egypt, China and even ancient Mexico had thier own channels, subteranean tunnels and other means of water supply.

More interest has been taken in the care of water and means of supply in the last century than ever before on account of the many diseases contracted therefrom. It was the repeated visitation of cholera and typhoid fever that brought about the first sanitary movement in 1832 and since that time the quantity but more especially the quality of water used has occupied a high place in public attention.

In 1867 England found it necessary to perfect their water systems and purify their water so they appointed a royal commission for the purpose of investigation and soon many changes were made and since

that time Englands water systems have been improved until today she may be proud of them.

The principal cause for the contamination is sewage and drainage from unclean lands and as the country is becoming more thickly populated each year it becomes harder to successfully deal with these drawbacks until today it takes the most skillful engineering testing, and often times many miles of piping at a great cost to give the inhabitants of a community first class water.

The ultimate source of all water is rain. When it falls on the earth it presents itself chiefly in the forms of surface collection, rivers springs, and lakes. There are several artificial sources such as reservoirs, common wells, artesian wells, etc.

Rain water as it forms in the upper regions of the atmosphere is absolutely pure but while falling it gathers all the impurities floating in the air with which it comes in contact also all of the impurities near the earth's surface and which are very numerous in the neighborhoods of towns and cities. These impurities consist mainly of the many kinds of gasses together with soot and every floating particle organic and inorganic.

Rain-water has a strong affinity for organic impurities which is to day corrupting ingredients

derived from vegetable and animal bodies and which are diffused over every surface in the vicinity of living beings. If however we resort to a barren rocky district which is destitute of all vegetation and far away from cities or towns we may obtainwater with very little organic impurity and in many cases not withstanding the several defects it is the best that can be had.

Water taken from streams or running water which has flowed immediately from beneath the surface or has been in contact for some time with the ground contains salime and organic matter to a more or less degree the extent of which depends to a great extent on the nature of the bed of the stream.

River water besides the impurities which they get from the sources contain mud, decayed leaves, etc., which makes it devoid of the clearness and transparency which is so essential to drinking water. The principal objections to river water however is the pollution from sewage and manufactures so that there are now few rivers left from which the water can be used in any way for domestic purposes without going through a process of purification.

On the other hands it may be said however of the river that just the supply from one large river is boundless and unfailing and conveys all drainage, washes

and irrigates thousands of acres of land without any expense as to the original source.

The simplest of all water supplies is that of a place in the country near a good spring and yet its true value is very seldom appreciated. As a rule springs contain the clear sparkling water that is pleasing to the eye and is practically of the same temerature in every season of the year, about 50°F. which is very cool and refreshing to the taste.

Springs are always aerated and are totally free from the offending odors so common in nearly all the waters as well as devoid of the animal matter generated by organic impurities. Springs, as a rule, are situated in the hills or mountains away from the contaminating influences of towns and cities and as they flow from directly beneath the surface of the ground they escape the impurities which are collected by streams and rivers while flowing in the open air and washing the impure lands along their banks. Spring water is given the highest place among all waters for domestic use where it can be had and where a sufficient number of springs can be collected to suffice for a town, it is the most desirable source of all water supplies.

Common wells, another source of water supply are probably the most universally used and still are

in many cases water in its worst form, The well is generally a cavity rudely lined with stones or possibly not lined at all and with an open mouth into which dust and many other impurities are blown by every breeze while foul surface water is trickling in from all sides.

In shallow wells, especially where they are exposed to the light there is generally a profuse vegetation on the bottom and sides and in addition to these impurities it is often further muddied by the dripping in of buckets which are not clean on the outside.

Wells in a town are even worse than these in the country on account of the poor sewerage and drainage in many places and many diseases and deaths are often traced to the impure water in wells, To keep wells in their best state they should be covered and carefully protected from the oozing in of surface water, etc.

Lakes vary quite perceptably in everyway, the size mostly, there are those fed by springs and emit through streams but do not receive through them, others get their supply from one or more streams but have no visible out-let while the greater number both receive and emit by streams,

For domestic use lake water as a whole cannot be highly recommended although many large water systems receive their supplies from lakes. In instances of this kind the lakes are situated in high altitudes

far away from the source of much contamination as cities towns, etc., and where vegetation does not grow promiscously on the very banks or extend down into the water. Generally these lakes are situated up in some rocky place where vegetation if very scarce and life is almost extinct.

The water in a lake of the lower regions is generally very sluggish on account of its being so situated that the basin receives all the drainage and refuse from the surrounding lands. In the case of a lake thus situated the outlet is very poor and the water sluggish, in fact the water remains in the basin so long that it becomes green or of a greenish yellow color fro impurities and as life is so preceptable and vegetation so thieving the water contains no little amount of organic impurities.

The smaller lakes which lie near towns and villages that could be used for a supply and water system are generally put to such a use as to make it impossible for most of them lie on private property and are used for watering places for the stock and here all the animals of the farm gather for the shade and cool air on the hot summer days.

Reservoirs are somewhat related to lakes in the way that there is no perceptable motion of the water. But if the water supply is large the water contained in the reservoir is continually on the move

from being drawn and fresh water run in. In cases where reservoirs are built too large for the supply the water should be regulated so that the reservoir would contain only about a half days use at all times, for if it contains more than the water has to stand exposed to the air too long especially in open reservoirs.

The greatest difference between reservoirs and lakes however is the fact that reservoirs have no dirt bottoms or sides and there is no immediate vegetation growing on its walls and it receives no drainage of any kind. The walls and bottoms of reservoirs should be lined with cement or well lain with brick or stone and kept clean, for if the water is left to stand in the reservoirtoo long a kind of scum or sediment will congregate on the walls and bottom which should not be allowed. In case the reservoir is made of brick or stone it should be seen that they are well lain for if this is not so vegetation of all kinds especially roots from the near by trees will force themselves through between them and the water will be no purer than a common pool.

Reservoirs by all means should be covered and kept dark ao things will not be dropped in by thoughtless people, so birds and small animals will not go there to bathe, also if it is kept dark animal life will not be so abundant as it is almost impossible for it to exist in dark places. Every precaution must be

taken in building reservoirs and supplying them for domestic use.

Water is technically a food and is as necessary as food. It serves as a diluent and as a solvent; it is also a neceasary ingredient of the plasma of the cells, maintaining the cell tugor and influencing partly by chemical and partly by its physical properties, the osmatic tension in the cells necessary to their healthful function. To most individuals two or three pts. of water a day are necessary, many need more but most people are healthier if they at least drink two pts. of water a day. The domestic uses of water are numerous Cooking, washing, bathing and etc., consume much. The care of streets,stables, and animals require it. The amount needed per person in the population is at least 12 gallons a day. Even 50 gallons of water a day is not too much.

Perfectly pure water is hardly to be found; rainwater and even artifically distilled water are only approximates. The chief impurities may be considered under the heads of mineral matter in suspension, mineral matter in solution and organic matters or those diseases due to infections micro-organisms animal or vegetable which may be found in the water used.

In the first group, or the mineral matter,

their may be included goitre, lead poisoning, zinc poisoning, chronic constipations and diarrheae. In the second various intestinal parasitic diseases, typhoid fever, cholera, dysenteries, diarrhoeas etc.,

A magnesium limestone formation was the most important factor in the water. Lead poisoning is not infrequent. Soft water acts on lead piping pracically in new houses. Chronic constipation is veryfrequently the result of drinking water impregnated with iron, salts and from drinking very hard water. When soft water and water in which there are traces of sulpher-atted hydrogen is used for drinking water, excessive diarrhoeae is the result.

Parasitic worms that can be conveyed throuh drinking water are the round worms and pin worms. The eggs of these worms are frequently found in drinking water derived from the subsoil and surface water.

The following are some of the tests that are used in finding out just what mineral matter is contained in water.

No.1. Test for calcium in water. Add to the water some ammonium hydroxide /NH4 O H and some N H 4 Cr. O4. If there is calcium in the water a white precipitate will be present. The mountain water gives a slight reaction.

No.2. Test for iron in water. Add to H2O

a few drops of hydrochloric acid, HnO3, and some potassium ferrocyanide K C NS and if there is iron in the water there will be a pink reaction. Tested some mountain water and found the pink reaction to be very slight.

The reaction was as follows:

Fe Cl3 3 K Cns - Fe (CnS)3 3 K Cl.

No. 3 Test for Aluminum in water. Add to the water a few drops of ammonium chloride and ammonium hydroxide in excess if there should be aluminum present in the H 20 there would after boiling be present a white flocculent precipitate. Tested the mountain water from the tap in the laboratory and obtained no reaction showing there is no aluminum in the mountain water.

No.4 Test for sulphates in water. Acidfy a sample of water with hydrochloric acid and add a few drops of barium chlorid Ba Cl 2. If there are sulphates present in the water a white precipitate will be formed after boiling. In the test on tap water I found the reaction is slight that it was hardly noticeable.

No.5 Test for chlorids in water. Add to some water containing a chloride a few drops of H No3 and ag No3 and a white precipitate will be formed. Allpied the same test to the mountain water and obtained no precipitate which goes to prove that there

is no chlorides present in mountain water.

The study of bacteriology has been as much the cause for the improvement of the water systems all over the world as anything else unless it was the great epidemics of cholera in 1887 in the city of Messina, Sicily and of typhoid fever in England in the year 1890. In both of these cases it was found that the water supplies were at fault.

The study of bacteriology began in the latter part of the seventeenth century. It is said to have orignated with the observations of Anthony Van Levenhock in the year 1675. This great man, who has been called the father of bacteriology was a lens grinder by trade and he became so efficient in his art that he succeeded in giving to the world a lense with which could be seen much more minute bodies than had heretofore been observed.

By the aid of this lens rain water was examined and found to contain unicellular organisms. These were rod shaped bodies having the power of motion. A little later through the aid of these lens it was discovered that there were organisms in the secretions and excavations of animal bodies. These discoveries set the people to thinking and after many experiments to see what these organisms could stand and still live. When they found out what a great deal of exposure they could staand, they began to think about their water

supplies and sewage.

According to the census return of 1900 they were 35 379 deaths from typhoid fever in the United States. The increase in morality over the number in 1800 is out of proportion to the increase in population. This, no doubt is due to the continued pollution of the water supplied.

The sewer had come into use long before the discovery of the germs of the infection of typhoid fever and cholera, and before it was positively known that the infectious agents in these diseases are contained in the discharges from the bowels.

Most of the large cities in the civilized world have a good water supply. The city of Vienna seeks its source of water in the Schneeberg Mts. New York draws its supply from large impounding reservoirs at the head quarters of the Bronx and Croton rivers. Boston depends upon artificial reservoirs impounding the stream flow of the Sudbury Cochitawate and Nashua rivers. Indianapolis obtains its water supply in deep wells in the limestone. Denver obtains its water from large impounding reservoirs in the valley of the South Platte River. One of the eight companies which furnish the water to the city of London draws its water from wells sunk in the London Chalk formation and all the other companies excepting the Kent works

draw their water from the Thames, Lea and New rivers with small additions from wells and springs for the supply ~~supply~~ furnished by the East London and New River Company.

Some of the cities depending upon rivers for a water supply are London, Liverpool, Rotterdam, Hamberg, Brumen, Berlin, Saint Petersburg, Albany, Philadelphia, Washington Cinncinnati, St. Louis, Nashville, Pittsburg, and Louisville.

Glascow Liverpool, Manchester, Zurich abroad and Milwaukee, Buffalo Cleveland, Chicago of the United States have their sources of water supply in lakes.

Among the many ways of conveying water to cities are first by gravity from natural lakes or impounding reservoirs at an elevation sufficient to furnish domestic and fire pressure. Typical examples of this method are found in New York, Boston, Baltimore, San Francisco and St. Paul, Second by pumping from rivers lakes or other sources to reservoirs placed at an elevation sufficient to supply under pressure water for domestic purposes.

Third, by pumping from the source mentioned above to stand pipes. And fourth by pumping into the distribution mains without the meter vention of stand pipes.

Made several bacterial examinations of the water in Corvallis and found the mountain water far the best. The examinations were made thus with the following results:

Made a plate culture by putting 10 cc of melted nutrient agar agar into a test tube to sterilize in steam. When the agar agar had cooled to body temperature 1 cc of H 2 O from a sterile pipette was added and the tube agitated. Poured the contents into a sterilized Pasteur dish and allowed it to solidify. Then placed it in the incubator for 24 hours at a temperature of 90 degrees. When the dish was taken out of the incubator spots could be seen on the agar agar These were the descendents of organisms in the water. Forty eight hours later I counted the organisms by the aid of a ruled plate placed over the Pasteur dish which gave the exact number of organisms present in 1cc of water.

TABLE OF WATER TESTED.

WATER	TIME	ORGANISMS	REMARKS.
Mountain	48 hours	47	Warm weather
Well 40ft.deep	72 hours	572	" " near barn
" 43 " "	72 hours	375	No barn, covered
Ditch	72 hours	5940	Warm weather
Well	48 hours	163	South end of town

Now that we have an exact knowledge of the causes of disease, which are impure water and poor sewage, the reason for the beneficient results attending good sewers in connection with an ample and pure water supply, is apparent. It may be said that a city or town having a complete and satisfactory sewer system and a pure water supply is immune from cholera or typhoid fever.