Hygiene of Indoor Swimming Pools, with Suggestions for Practical Disinfection.

By Severance Burrage.

The "Ole Swimmin' Hole" of our boyhood days is doomed. The favorite spot in pond or stream to which we used to go after school for a good swim and play, with no thought for the microbe in the water nor the bathing suit for our bodies, is, for the boy of today almost unknown, and for the boy of the future will be but an unrealizable dream. With the advance of civilization these swimming holes are being replaced by public bath-houses, and to these, or to gymnasiums that are provided with swimming tanks, the boys must go for their swim. The streams and ponds have become polluted to such an extent that it is dangerous for the boys to bathe therein. This is the result of the increase in population, coupled with the great carelessness of individuals and communities in the disposal of wastes. This replacement of the natural swimming pool by the indoor swimming pool may carry with it new unhygienic conditions, and it is a discussion of these conditions and their elimination that forms the purpose of this paper.

CONSTRUCTION OF INDOOR SWIMMING POOLS.

One of the first requirements in the sanitary construction of the indoor swimming pool is that it must be so constructed that it may be easily cleaned. To this end the surface of the lining material of the pool should be very smooth, such a surface as is provided by glazed tiles so laid as to avoid all cracks and crevices. At the angles formed by the meeting of the sides and floor of the pool, curved tiling should be used, which would give the same result in the border of the pool flooring as is obtained in the angleless baseboard in up-to-date hospitals and operating rooms. The almost universal deposit of a slimy sediment in these pools, even when the water is comparatively clear, makes it necessary to provide for an easy and complete cleaning. A concrete or cement lining, made as smooth as it is possible to make it, furnishes a surface that is difficult to keep clean.

[10—23003]

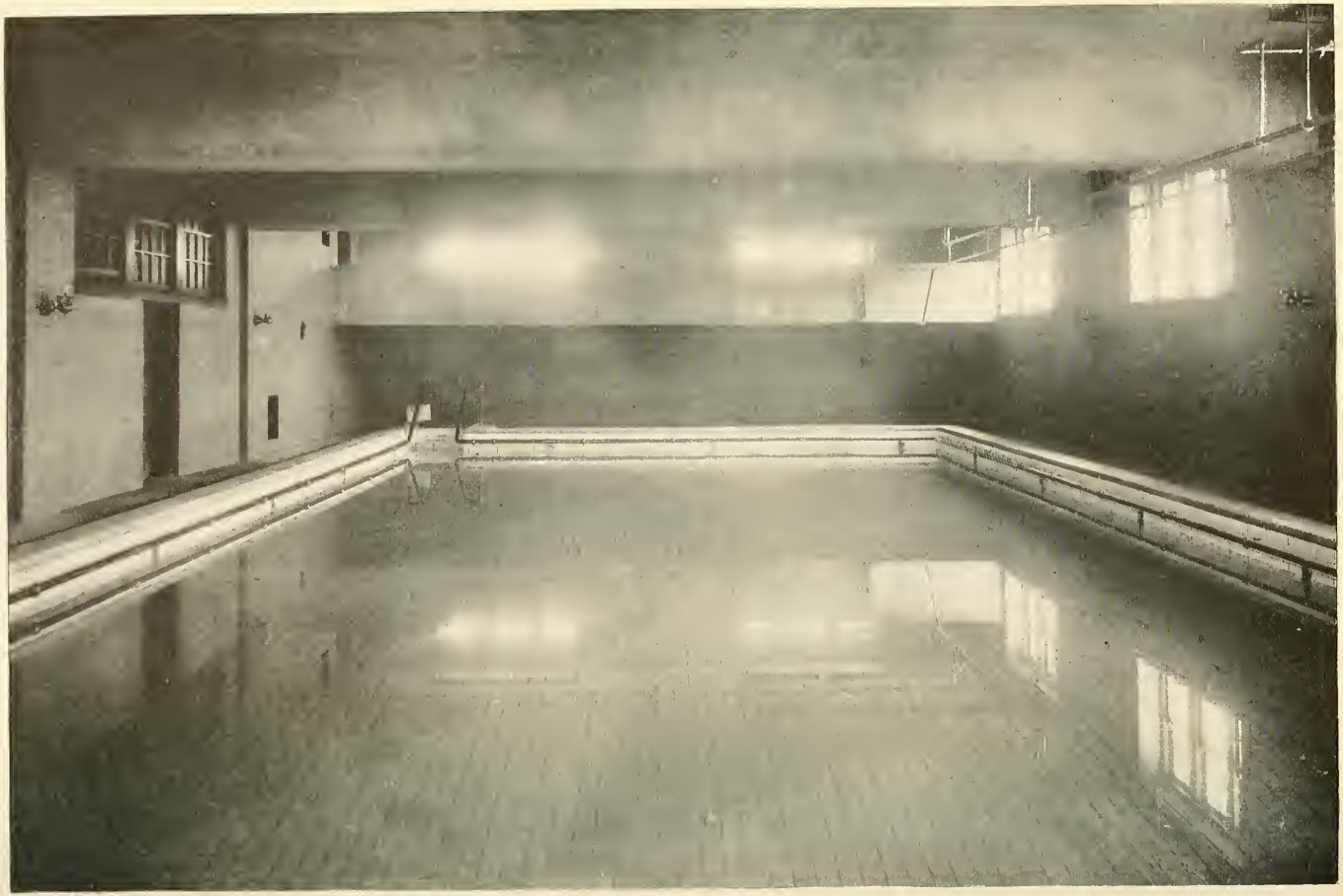

Fig. 1. Swimming Pool, Memorial Gymnasium, Purdue University.

A swimming pool lined with the glazed tile referred to above is shown in Fig. 1, Purdue University Memorial Gymnasium, 1909.

In addition to the outlets for the water in the bottom of the pool, it is advisable to have, at the overflow point, a sufficient number of outlets, or a trough extending all around the pool, so that when a scum or dirt collects on the surface of the water, the upper layers may be drawn off without necessarily emptying the whole pool.

Fig. 2. Men's Swimming Bath, Leeds, England. (Lighted by sky-light only.) By courtesy of "Modern Sanitation."

The floor of the pool room should be so drained that water dripping from bathers who have come out of the pool can not collect in puddles, and, furthermore, such water should drain, not back into the pool, but into the overflow waste pipes.

The Water Supply.

The water supplied to the swimming pool must be pure, and every possible means used to keep it so during and after its use by the bathers. The nearest approach to an ideal water supply for an indoor swimming pool would be the provision for a pure water to start with, and a continuous change of water, during the use of the pool, the rate of this change being governed by the number of bathers in the pool. In most cases this is out of the question on account of the expense.

The water of these pools is not exposed to the many purifying factors that affect out-door waters. The pool is usually located in the basement or in buildings the interior of which the direct rays of the sun seldom reach. Thus one of the most important factors in the purification of natural waters is removed. It is true that the water does get some

aeration while the bathers are stirring it up, but because of the constant contamination at such times, this aeration cannot be counted upon as very much of a purifying factor. During the times when the pool is not being used, when the water is stagnant, no purification is taking place. On the contrary, bacteriological tests have shown that there is an increase in the bacterial content, particularly if the water has been warmed up to a temperature of 75 degrees Fahr. or over. There is considerable sedimentation during such times, but if this sediment remains in the bottom of the pool to be stirred up when the bathers next use the water, this cannot be looked upon as purification.

The cold plunge at the Fleischmann baths, New York City[1] has "enormous windows of plate glass facing south and the medicine of the sun and the glory of the sky." (Fig. 6.) Comparing this elegant sunny pool room with the condition in our average basement swimming pools,

Fig. 3. Women's Swimming Baths, Leeds, England. (Direct sunlight rarely reaches water.) By courtesy of "Modern Sanitation."

it makes the latter look dark and gloomy. The pool room at the Purdue gymnasium is on the south side of the building, and the windows are large for a basement room, and yet even this does not get the necessary sunlight for purposes of purification of the water.

At the swimming baths at Leeds, England (Cookridge street), the skylight is used for lighting the rooms, but even here the effect is none too brilliant. (Figs. 3 and 4.)[2]

---

[1] Lucy Cleveland, Modern Sanitation, Jan., 1908.

[2] Henry Gray, Modern Sanitation, Oct., 1909.

Pollution of Water by Bathers.

A bacteriological study of the water used by a bather at the Victoria Baths at Bonn,[1] shows well the character and amount of pollution that may take place in public baths. The test was made on a stoker (Heizer), who was made to wash in a tub for three minutes, using no soap. Before the test, the bath water contained 24 bacteria in a cubic centimeter, and no *Bacillus coli*. After the three minute washing, the bath water contained 1,900 bacteria and 40 *Bacillus coli* in each cubic centimeter.

Bacteriological tests made by the writer on the water of the swimming pool in the new memorial gymnasium at Purdue University demonstrated the presence of 930 bacteria per cubic centimeter in the water of the pool before being used by the bathers. After use by about thirty bathers, all of whom were supposed to have taken a soap shower before entering the pool, the bacterial content was 109,200 per cubic centimeter. Tests were made for *Bacillus coli*, and the results were consistently positive after the pool had been used. The water immediately after cleaning the pool and refilling gave consistently negative results for *Bacillus coli*.

The available literature gave almost no data as to bacteriological analyses of swimming pool waters.[2]

Disease Dangers in Swimming Pools.

There are great chances for the dissemination of germ diseases through indoor swimming pools. The results of the bacteriological tests given in the preceding paragraphs, which showed the constant presence of the *Bacillus coli* in the water used by bathers, demonstrates the possibility of intestinal diseases, particularly typhoid fever. While bathers do not swallow the water intentionally, it is next to impossible to avoid getting some water into the nose and mouth, which would ultimately reach the intestinal tract. One does not have to be sick or to have any symptoms of typhoid fever to disseminate the germs of that disease. This is well shown in the notorious case of "Typhoid Mary" in New York.[3]

Diseases of the respiratory tract have an unusual chance to be spread in the swimming pool. The bather with incipient tuberculosis, pneumonia

---

[1] Zur Hygiene der Hallenschwimmbade. Dr. Selter. Aus dem Hygienischen Inst. der Univ. Bonn. Rundschau, Dec. 1, 1908.

[2] Hesse, Dresden. Zeitschrift f. Hyg. Bd. 25. Eden, Berlin. Arch. f. Hyg. Bd. 19. Koslik, Gratz. Diese Zeitschr. 1898, S. 361.

[3] Whipple. Typhoid Fever.

or tonsillitis, with his sputtering, coughing, snorting and spitting, would undoubtedly infect the water with the specific germs of those diseases. Ordinary colds and sore throats following the plunge bath are frequently laid to the effects of the bath, while in most cases such results are undoubtedly due to germ infection. One of the factors which lead the writer to take up this subject was an epidemic of colds among the users of the Purdue swimming pool this fall.

Venereal diseases could be transmitted through the agency of the swimming pool. One case of gonorrhoea could infect many eyes in a crowded swimming pool.

It is practically impossible to compel the bathers to submit to a complete medical inspection and physical examination before they are allowed to enter the pool, and yet from many points of view this would be a most desirable thing.

The least that can be done for the protection of the bathers is to insist that certain rules be strictly adhered to. For example, such rules as the following are posted prominently in the Purdue gymnasium:

TAKE A SOAP SHOWER BEFORE ENTERING POOL.

All gymnasium privileges will be denied persons affected by any contagious or communicable disease.

All persons MUST take a soap shower before entering the pool.

All persons using the pool MUST wear bathing suits or trunks.

Of course facilities must be provided for the required showers, and each person should provide his own towel and soap.

In the Central Baths, Bradford, England, special arrangements are provided for washing the feet,[1] a most desirable thing as a prerequisite to the use of the pool. (See Fig. 7.)

PRACTICAL PURIFICATION OF WATER IN SWIMMING POOLS.

The amount and character of the pollution in swimming pool waters point very clearly to the need of some practical process of purification. In most cases it is too expensive to have a continuous change of water, and

[1] Centralized Public Baths. Bertha H. Smith, Modern Sanitation. November, 1909.

in some too expensive to change the water once or twice a week. At the Central Baths, Bradford, England, the water is filtered. The expense of pumping the water and caring for the filter does not make the filtration process a particularly economical one.

It occurred to the writer that some chemical, as copper sulphate or chloride of lime, both of which are being used extensively in the purification of sewage and sewage polluted waters, might be used in the treatment of swimming pool waters with but small expense. Inquiries in many directions and a careful search in available literature resulted in but scant information. A single reference[1] reported the use of a chemical, an "electrolytic fluid," by the medical officer of health of the metropolitan borough

Fig. 5. Plunge, East 23d St. Public Bath, New York City. (A fairly well lighted indoor pool.) By courtesy of "Modern Sanitation."

of Poplar, Mr. F. W. Alexander. This fluid is obtained by the electrolysis of a solution containing magnesium chloride, the result being a solution of magnesium hypochlorite. Treatment of water in swimming baths by this fluid was thought to be simple, economical and efficient, bacteriological tests on water so treated giving sterile results.

Before finding this reference the writer had conducted a series of tests on the water of the swimming pool at the Purdue gymnasium, using chloride of lime.

Commercial chloride of lime (bleaching powder) is usually manufactured by passing dry chlorine gas over freshly slaked lime, the chlorine

[1] Scientific American Suppl. No. 1765, Oct. 30, 1909.

being obtained by the electrolysis of salt. This chloride of lime is composed largely of calcium hypochlorite. When added to water this hypochlorite dissolves, leaving a residue of calcium hydrate and calcium carbonate. Both of these substances are entirely harmless factors in a bath water. The oxidizing power of the commercial chloride of lime is represented by about 35 per cent of available chlorine. It is nascent oxygen that is the purifying factor, not the chlorine.

The capacity of the Purdue swimming pool is 85,000 gallons, and 680 grams of the chloride of lime were used at each dose. This would be about the equivalent of 20 pounds to the million gallons. Before starting the experiment with the chemical, bacteriological analyses were made of the water for a week, the pool being emptied twice. No attempt was made to keep track of the number of bathers in the pool.

The following table shows the results of the analyses for the week before using the chemical dosage, compared with the results of the analyses for the week while the dosage was going on. During the latter week, that is, while the tank was being dosed with the chemical, the water was not changed at all.

The method of applying the chemical was to sprinkle it on the surface of the water in the pool. This was easily done with one trip around the edge, throwing the powder as one walked. The time occupied in this process was less than two minutes.

Date.	*No. of Bacteria per c. c.*	*B. Coli.*
Monday, November 1, pool just filled	560	None
Evening, after use	6,160	Present
Tuesday a. m., November 2	20,650	Present
Evening, after use	37,600	Present
Wednesday a. m., November 3	27,800	Present
Evening, after use	60,500	Present
Tank emptied.		
Thursday a. m., just after filling	930	None
Evening, after use	8,500	Present
Friday a. m., temperature of water 85 Fahr	109,200	Present
Evening, after use	106,400	Present
Saturday a. m., November 6	118,000	Present
Evening, after use	140,000	Present

Monday, November 15, pool freshly filled.....	780	None
Evening, after use.....	23,100	Present
Pool dosed with 680 grams chloride lime.		
Tuesday, November 16, a. m.....	26	None
Evening, after use.....	12,000	Present
Pool dosed with chloride of lime.		
Wednesday a. m., November 17.....	14	None
Evening, after use (no sample).		
Pool dosed with chloride of lime.		
Thursday a. m., November 18, water had not been changed as was usually done.....	9	None
Evening, after use (no sample).		
Pool not dosed.		
Friday a. m., November 19.....	11,200	Present
Evening, after use.....	20,500	Present
Dosed with chloride of lime.		
Saturday, November 20.....	18	None
Evening (no sample).		

A study of the results shown on this table indicates that the effect of the chloride of lime treatment is almost complete sterilization. The samples of water taken the morning after the water had been dosed in no case showed more than 26 bacteria per cubic centimeter. And what I believe to be a very important factor is that the general average of the bacteria is lower, much lower, than during the week when the chemical was not used. The effect of stopping the dosage is prettily shown in the Friday morning sample, November 19. The pool is used by the "coeds" and faculty ladies on Thursday evenings, and it was inconvenient for the writer to arrange to have the sample collected. No arrangement was made to have the chemical applied.

SUMMARY AND CONCLUSIONS.

There are certain dangers to health in the indoor swimming pools. The construction of the pools, the enforcement or neglect of rules governing those who use the pools, the proper attention to the water supply, as to its purity before use by the bathers and after use, all have a direct bearing on the extent of these dangers.

On account of the expense it is practically impossible to provide for a continuous change of the water. The filtration of the pool water after use also involves some trouble and expense. The use of certain disin-

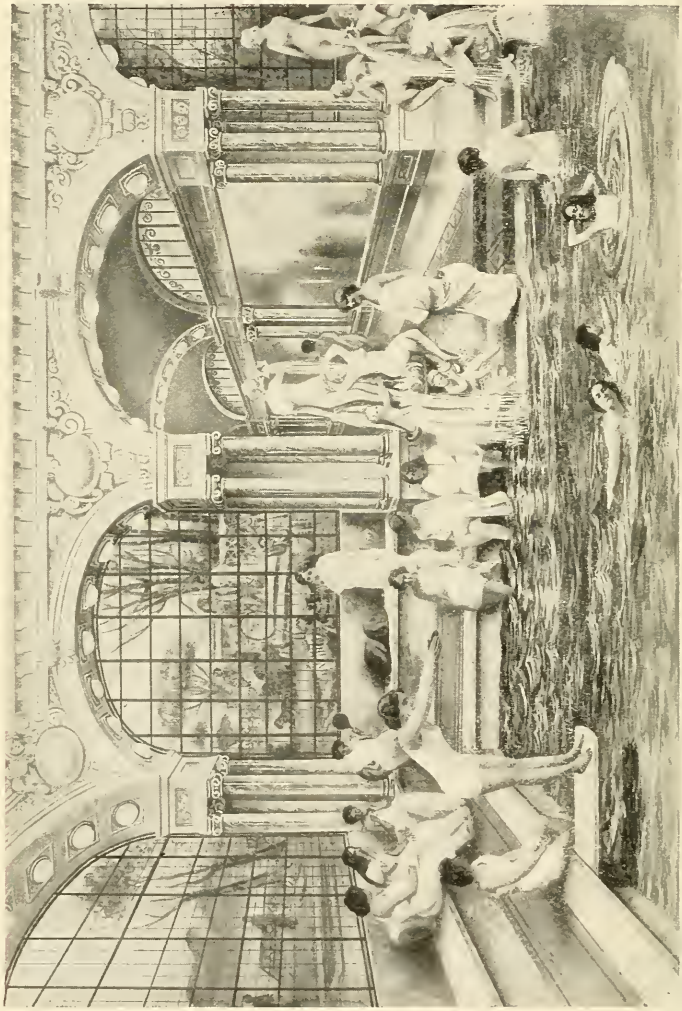

Fig. 6. Plunge, Fleischmann Baths, New York City. Women's Hour. (Showing unusual lighting for an indoor pool.) By courtesy of "Modern Sanitation."

fectants would seem to be more simple and economical. The writer would criticise the liquid or fluid chemicals as being harder to apply to the pool

water. They would have to be thoroughly stirred into the water. The substance used by the writer, chloride of lime, is sprinkled on the surface of the water, and it to a great extent distributes itself by sinking through the water. The results of the bacteriological tests certainly indicate that the substance has a very great purifying power.

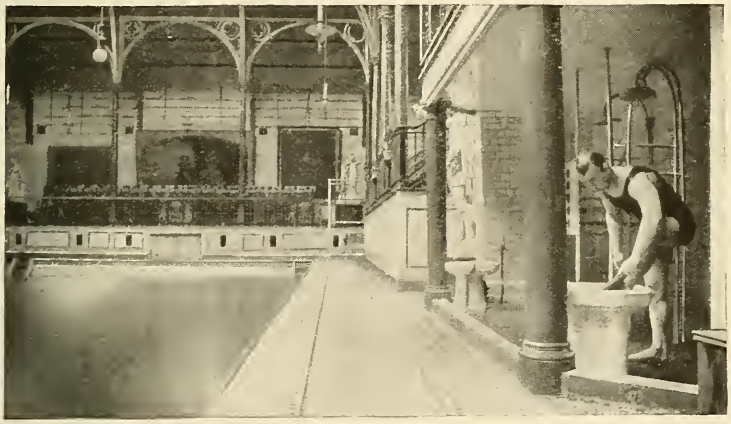

Fig. 7. Facilities for foot-bath before entering plunge. Bradford, England. By courtesy of "Modern Sanitation."

The indoor swimming pool is a valuable hygienic factor in our public baths and gymnasiums. It makes the bath attractive to many who would otherwise look upon bathing as a bore. Anything which will tend to make the boys and girls, youths and maidens, men and women bathe more frequently is desirable. But the swimming pool has its dangers, and most of these depend not upon the users of the pools alone, but much more on the construction and management of them. Therefore we must look to the builders and directors of our baths and gymnasiums for the satisfactory hygiene and sanitation of indoor swimming pools.