The difference L — 5h must be algebraic, and in multiplying by 0s.16 it must be expressed in minutes of time.

To illustrate this, take the following example:—At a place in latitude 49° 20′ N., longitude 80° (= 5h 20m) W, an observer wishes to take an observation for azimuth between 8 and 9 p.m. on September 8th.

Here the interpolated value of the azimuth for 8h 30m is 1° 48′ 10″, interpolating by second differences, and the corresponding time for the given longitude and date is:—

8h 30m 00s
+ 19 56.8 (= 20m — 20 × 0s.16)
— 27 31.3 (= 3m 55s.9 × 7)
=8h 22m 25s.5.

To determine the meridian the observer then points to the pole star at the above computed time, after setting his vernier at a reading equal to the above azimuth, clamps the horizontal circle, and then turns the vernier to zero.

Determination of Time.

If the direction of the meridian is known approximately, the correction of a watch on standard time may be found by observing the watch time of transit of a star. The star's R.A. is then the sidereal time of transit, and the corresponding standard time may be found as follows:—First find the sidereal time corresponding to one of the standard times of the above table for the date and place of observation by the formula: $S = S' + d \times (3m\ 56s.555) - (L - 5h)$.

Where

S = the required sid. time.
S′ = the tabular sid. time,

and d and L have the same meanings as above. Then the required standard time of transit of the star follows by the formula:— $T = T' + (\alpha - S)\ (1 - 0s.16)$.

Where

T = the required standard time of transit of the star, and
T′ = the tabular time corresponding to S′.
α = the star's R.A.

To illustrate the use of these formulae, let us assume that the meridian transit of the star Altair is observed at the watch time 8h. 56m. 49s. 5 at the same place and date as above; to find its correction on standard time.

		h.	m.	s.
Sidereal time, 9h. 00m. (table).....	=	19	42	19.8
7 × (3m 56s. 555)	=		27	35.9
		20	09	55.7
Difference of longitude	=		20	00
S	=	19	49	55.7
R.A. of star	=	19	46	22.5
α — S	= —		3	33.2
3.6 × 0s.16	=			0.6
Equivalent mean time interval.....	= —		3	32.6
T′	=	9	00	00
T	=	8	56	27.4
Watch	=	8	56	49.5
Watch fast	=			22.1

The methods described above do not take account of changes in the star places, but with ordinary field instruments and for short periods of time these are negligible.

REMOVAL OF PUTRESCIBILITY.

(Continued from page 237.)

taining a 99.7 per cent. reduction, viz., 2,000,000 to 5,500 per c.c. The Berlin sewage showed a count of deplorable bacteria to the amount of 12,750,000 per c.c.; the effluent containing only 3,570 per c.c. or a reduction of 99.9 per cent.

All this points to one definite conclusion, that the effluent from the very best of well managed sewage farms is never suitable for drinking purposes. Such effluents invariably retain the bacteriological characteristics of sewage. The best effluents contain B. coli in considerable numbers, and it must be assumed that even typhoid germs may pass through the soil and reach the streams receiving the effluents. Dr Houston has made this evident in the thorough investigations he has made for the Royal Commission.

It is, however, apparent that land intermittent filtration properly managed may produce a very high efficiency in bacterial removal. Fortunately the pathogenic bacteria of sewage are not found isolated and free to move about in the sewage liquid, they are generally enclosed or in contact with diarrhœa stools or wrapt up in gelatinous masses or generally attached to suspended matter. If the solids in suspension are first allowed to settle in tanks, a percentage of bacteria about equal to the amount of settled solids will be removed by this preliminary treatment, and further methods of straining or filtering will have an effect of still greater reduction. The main point to be kept in mind is that if the water receiving sewage effluents either raw or treated is to be used for drinking purposes such water should be treated by one of the many well known methods for biological purification.

The utilization of the manurial properties contained in sewage is frequently an argument in favour of land treatment. The most important manurial constituent in sewage is the ammonia which is the product of the fermentation of urea of the urine. Sewage also contains organic nitrogen in a smaller quantity as well as potash salts and phosphates. With artificial biological filtration, part of the ammonia and other organic compounds disappear in the form of gases, part is assimilated by the vegetable growths in connection with the bacteria film and the remainder of the nitrogen is oxidized into nitrate. The following table shows the amount of nitrogen which are used up or disappear in land as compared with other methods. (Royal Commission, par 205.):

	Percentage of the Nitrogen of Sewage or Sewage Liquor which disappears during the process of purification.
Land intermittent filtration....	about 60 per cent.
Percolating biological filters...	40 to 50 per cent.
Septic liquor in contact beds...	40 to 45 per cent.
Septic liquor in percolating beds	30 to 40 % or less.

From the above it will be seen that there is from 10 to 30 per cent. more nitrogen retained or used up in soil than in artificial methods, the balance has chiefly vanished by being used up by growing crops. Much has been written of the general loss of nitrogen and its non-utilization by the adoption of artificial filtration. It must be remembered, however, that it is only in the form of nitrates that nitrogen can be of any benefit to plant life, and that the production of nitrates in soil in winter time almost ceases. Speaking generally, intermittent land filtration has only proven successful when crop growing has been entirely subservient to purification of the sewage. It is practically necessary to dose land, unless the area is very large, almost continuously. On the other hand there are times, especially in wet weather, when the plant life is destroyed by the excess of sewage liquid. No case is known where a profit is shown by growing crops in sewage dosed land when all the costs of sewage treatment are considered. Theoretically the value of a domestic sewage has been calculated at from $1 to $1.25 per head per annum. No returns in practice have come anywhere near this figure.

Over and over again the system has been tried in Great Britain and in Europe of renting the plots of land used for intermittent filtration to gardeners and others who desired to cultivate the land, the system has invariably proved a failure. All kinds of tricks are resorted to by the tenants of the plots to divert the sewage in wet weather from the land surface, by making holes direct to the underdrains or opening sluices and diverting the sewage direct to the stream. It must be either a question of sewage treatment or cropping, if cropping the purification will suffer. All the wild schemes in the past of utilizing domestic sewage for purposes of profit have proved bubbles, and it is only in exceptional cases of trade effluents and grease recovery that by-products have been made to show any profit.

(To be Continued.)