

Correlative evidence indicates that the Warburton Range assemblages of acid and basic flows and sills and interbedded sediments, belong to the Nullagine formation.

### 3.—SUMMARY OF A REPORT ON A SAMPLE OF STINKSTONE (STINKSTEIN) FOUND IN A LIME DEPOSIT ON BOOLARDY STATION, MURCHISON DISTRICT.

(T. Blatchford, B.A., and F. G. Forman, B.Sc.)

From the inspection carried out in the field and from information otherwise obtained, we have arrived at the following conclusions:—

1. Most of O.P.A. 236H is occupied by granite on which may be shallow surface deposits, but deep basins would be most unlikely.
2. The stinkstone is not confined to the spot where it was first found, but was located in four other places by us, so it is probably fairly common.
3. Where found it was evident that the stinkstone was definitely a variety of travertine limestone, usually the darker variety, occasionally the yellow, but never the really white.
4. The stinkstone does not occur in a regular limestone bed similar to oil-bearing limestones in other countries, but is a surface deposit.
5. Confirming field evidence, analyses of the samples collected show no signs of petroleum.
6. In our opinion, therefore, the occurrence of stinkstone at Boolardy Station has no bearing whatever on the possible occurrence of mineral oil in that area.

### 4.—FINAL REPORT ON THE CORRELATION OF THE ARTESIAN BORES IN THE METROPOLITAN AREA, PERTH.

(F. G. Forman, B.Sc.)

Investigation shows that the information available is insufficient and of too doubtful a character to be used in the production of an accurate sub-surface contour map, indicating the depth below the surface of the various artesian water beds.

The reasons for this conclusion are as follows:—

1. The majority of the bore records available depend on drillers' logs only for a description of the strata passed through. A comparison of the drillers' logs with determination of the strata made by officers of the Geological Survey in the few instances where the cores have been examined by them, shows the drillers' determinations to be often much in error and of very doubtful value.
2. In those cases where sections of the cores have been preserved, there are insufficient samples to allow of these cores being used for accurate correlative purposes.
3. There is great uncertainty in many of the boring records as to the exact depth at which the flows began, in many instances there being in the record simply a note of the amount of flow in gallons per day at a particular depth, the depth at which the flow started being omitted.

4. It has been the custom to record the temperature of the water and its static head only after completion of the bores so that these records for correlative purposes are of doubtful value. The same applies to water analyses.

5. On a study of the bore logs in the Claremont District, it appears that the strata are displaced between the Claremont No. 1 and No. 2 Bores. Lack of information as to the direction and amount of throw of this fault and the possibility of faulting in other parts of the Metropolitan Area make any sub-surface contour plan, drawn without more information than is at present available, of very doubtful value.

The following conclusion has been reached as the result of this investigation:—

The base of the coastal limestone series, consisting of current bedded calcareous sandstones, lies at elevations varying from sea-level to as much as 180 feet below sea-level in different parts of the Metropolitan Area.

Underlying the coastal limestone series there are lacustrine deposits of soft calcareous shales and sandstones passing downwards into a series of marine beds of calcareous shales or mudstones, sandstones and impure limestones. All the beds present are extremely lenticular.

Under the Metropolitan Area there are three distinct artesian water-bearing horizons. These horizons can be distinguished by water analyses, static heads and temperatures of the various flows. The horizons when contoured from bore to bore are found to be unconformable and it is suggested that the water-bearing horizons lie on the surfaces of the unconformities, because of the frequent occurrence of extremely coarse sands and small boulders in the water-bearing zones. These sands are in distinct contrast to the fine-grained nature of the other sediments throughout the series.

Of the three horizons, the upper two have a limited distribution. The upper horizon is met with in the bores in the vicinity of the city and at Osborne Park, and it is thought that the bores of the Guildford District also draw their water from this horizon. The second horizon is met with in the bores in the Leederville District and in the King's Park bores on Mount's Bay Road. The third horizon covers a larger area, having been encountered in all bores of sufficient depth.

In the attached table the various bores in the Metropolitan area have been divided into groups according to which horizon each bore derives its main supplies of water. In the case of those bores which draw by separate casings from two horizons, the separate flows have been listed in their respective groups. Details, where available, of water analyses, temperatures and static heads are also shown.

Three main artesian water horizons can be recognised and these have been named, for purposes of reference, according to the district in which each horizon has been chiefly exploited by boring. As will be seen from the table, these are the Claremont-South Perth, the Leederville and the City horizons, which occur in that order from the lowest upwards. Owing to the relatively isolated positions of the bores at Fremantle, Guildford and Midland Junction from the remainder of the bores in the Metropolitan Area these have not been correlated, as it is considered that too great an uncertainty exists to allow of this being done.

The following facts stand out clearly from the table. The waters from the Claremont-South Perth and the Leederville horizons have a carbonate content varying from 10.6 to 15.8 grains per gallon. This is in distinct contrast to the carbonate content of waters from the City horizon, which varies from 4.6 to 7.2 grains per gallon.

It will be noticed also that in the case of the two lower horizons the chloride content of the waters is generally higher than that of waters from the City horizon, although in this case there is not the same marked difference as shown by the carbonate content.

The temperatures of the various waters show a definite variation from one horizon to another. In the Claremont-South Perth horizon the temperature varies from 100deg. to 105deg. F., in the Leederville horizon from 88deg. to 95deg. F., and in the City horizon from 75deg. to 81deg. F. This association of definite temperature groups with the several water horizons is probably only of a casual nature as the temperature of the water should be, and probably is, a function of the depth of the aquifer below the surface.

The last column in the table shows the static head of the water in the various bores expressed as height above sea-level at which the water should come to rest

\* Exceptions to this will be discussed later.

if confined in a column. The water in the Claremont-South Perth horizon has a static head varying in different bores from 110 to 121 feet above sea-level. The static head of the Leederville horizon varies from 70 to 94 feet and that of the City horizon from 58 to 81 feet. It will be seen that the static heads in the Leederville and City horizons are much the same and will not serve to separate the two. It is suggested that this is due to equilisation of pressure caused by the two aquifers coming together because of the unconformity between them.

The temperatures and static heads of several bores show variations from normal. At the Coffee Point bore, which, according to water analysis and from a study of cross sections drawn between various bores, should belong to the Claremont-South Perth group, both the temperature and static head are abnormally low, being 91deg. F and 48 feet above sea-level respectively. An explanation is difficult, as the boring record does not show that upper waters with a low temperature and pressure were passed through, which might account for these abnormal conditions by leakage. It is suggested that the low static head of 97 feet for the Redan Street bore is probably due to this cause. It is also suggested that the abnormally high temperature of 104.5deg. F. of the water from the 10in. casing of the Loftus Street No. 1 bore is due to conduction of heat from the 8in. casing, which carries water at that temperature.

Name of Bore.	R.L. at Surface. Feet above sea level.	Total Depth. Feet.	Depth to Principal Water Bearing Horizon. Feet.	Analysis.**				Temp. of Water. °F.	Static Head. Feet above sea level.
				Car-bonates.	Sulphates.	Chlorides.	Total Solids.		
				Grains per gallon.					
Claremont No. 1	24.41	1,506	1,189	12.39	3.22	55.79	72.04	100	110
Claremont No. 2	30	1,943	1,558	15.82	2.24	40.32	59.64	104	110
Claremont Hospital for Insane	70	2,070	1,848	15.52	2.24	40.95	60.20	104	112
Coffee Point	9	1,487	1,487	11.72	3.35	45.04	61.02	91	48
King's Park No. 2	11	2,406	...	10.08	3.08	42.07	55.86	100.4	110
Leederville Sanitary Site	70	1,680	1,375	...	...	...	...	...	...
Loftus Street No. 1—Sin. casing	45	1,939	1,780	11.01	3.48	42.26	56.40	104.5	110
Loftus Street No. 2	45	2,097	1,780	14.01	4.80	73.08	90.81	105	110
Old Men's Home, Claremont	17	2,196	1,828	...	...	...	...	...	...
Redan Street	47.2	1,812	1,024	11.42	4.20	30.48	47.55	100.5	97
Royal Agricultural Society, Show Ground	54	1,500	1,320	12.25	3.22	57.26	74.13	...	110
South Perth Zoological Gardens	18	1,856	1,837	13.19	4.50	46.43	...	...	121
King's Park No. 1	11	1,345	...	13.44	4.83	58.38	76.86	88	94
Leederville Recreation Ground	59	1,113	1,023	14.48	1.96	21.48	39.23	...	70
Loftus Street No. 1—10in. casing	45	1,001	945	10.60	5.67	73.32	89.72	104.5	87
Regent Street	...	1,232	881	12.36	3.00	33.06	52.56	89	71
Subiaco Municipal	117	876	876	14.70	3.99	23.87	42.98	95	74
Causeway	10	1,200	747	4.62	4.97	55.54	68.08	...	70
Hector Street	51	762	762	6.00	0.34	38.6	50.08	81	80
King Edward Street	...	568	480	...	...	...	...	75	...
East Perth Tramways	53.6	1,034	1,010	5.63	0.36	17.97	25.72	...	81
Roberts Street	30	631	490	5.75	0.67	12.94	20.21	76	63
W.A. Cricket Association Ground	12.9	948	498	...	...	...	...	...	62
Wellington Street	35	815	600	6.45	2.20	32.07	...	...	58
West Perth Station Yard	38	820	820	7.20	3.40	34.05	48.15	...	73
Bebo-Moro or Gull's	19	408	408	10.36	2.10	20.16	34.02	...	37
Brookman's Estate, Cannington	...	1,000	313	8.64	13.83	114.11	137.91	...	20
Butcher's (Garden Hill)	...	494	199	5.20	trace	22.17	38.50	...	21
Guildford Municipal	11	1,202	1,140	5.94	9.42	74.84	92.55	...	64
Hampton Road, Fremantle, No. 1	64.23	456	434	8.40	5.25	53.13	63.53	80	24
Hampton Road, Fremantle, No. 2	68.38	1,322	433	8.61	5.04	58.31	73.64	...	75
Harper's No. 1	14	236	160	6.65	0.17	20.79	34.03	...	...
Harper's No. 2	...	242	160	...	...	...	...	...	33
Lockeridge or Hamersley's	14	798	784	4.47	trace	10.39	23.41	...	21
Midland Junction	...	500	420	7.20	0.36	42.33	56.28	...	...
Midland Junction Municipal	13	618	564	...	...	42.34	...	...	...
Midland Loco. Workshops No. 1	43	322	280	4.68	4.93	37.83	49.40	...	33
Midland Loco. Workshops No. 2	24	890	600	3.25	4.58	50.91	65.08	...	176 (?)
Midland Loco. Workshops No. 3	...	382	...	4.90	4.94	39.73	51.97	...	...
Midland Loco. Workshops No. 4	...	353	...	...	...	...	59.04	...	...
Midland Loco. Workshops No. 5	...	218	...	...	...	...	...	...	...
Munday's	22	340	304	...	...	...	32	...	32
Nicholson's	...	400	302	...	...	...	...	...	...
North's	...	589	199	3.54	4.27	41.58	52.03	...	...
Padbury's	...	755	347	8.89	1.61	24.08	36.12	...	46
Perth Racecourse No. 1	40	1,100	1,070	4.89	0.85	22.18	31.89	...	59
Perth Racecourse No. 2	...	1,109	1,075	...	...	...	...	...	...
Waterhall or Morrison's	35	691	691	4.48	4.69	49.63	62.44	...	46
West Guildford	...	1,410	1,395	10.63	16.24	132.76	162.10	...	28

\*\* These figures are compiled from the reports of the Interstate Conferences on Artesian Water (1912, 1914, 1921, and 1924), and from information supplied by the Government Mineralogist and Analyst.