plant, and the charging of the briquettes more easily effected by means of a shaped iron paddle.

Once charged, the procedure for the recovery of the zinc is identical with ordinary practice, although the action within the retort is of a different character. The briquettes, as they reach the temperature of distillation of coal, coke into coherent masses, with evolution of volatile hydrocarbons. Reduction of the lead simultaneously occurs, the minute metallic particles entirely permeating, and being held up in the pores of the coke, whilst, at the higher temperature shortly afterwards reached, zinc oxide is reduced, and yields metallic zinc vapours, which are condensed in pipes, these are tapped at intervals in the ordinary way. The distillation occupies the normal time.

We draw attention to the remarkable fact first noticed at the outset of our experiments, now confirmed by some years' experience, that, whereas in ordinary practice lead distils to a marked extent in zinc vapour, in our process the whole of the lead, as also the silver and gold, is retained by the coke. The latter thus appears to exert an actual physical retardation of the volatility of lead in a slow current of zinc vapour. So definite is this advantage, that we find the spelter thus produced from Broken Hill ores to be of exceptional purity, averaging 99 p.c. of metallic zinc, and commanding prices equal to that of the best brands produced from lead-free ores. This spelter is already in considerable demand, owing to its low lead tenour, which does not often exceed ½ p.c.; it can thus be employed for the manufacture of the finer kinds of brass, for which the ordinary brands, containing from 1 to 2½ p.c. of lead, are useless.

The zinc having been recovered, the seconds are withdrawn from the pots (pipes and luting clay having been removed, and sweeps collected) and discharged into the caves, whence in usual practice they would be dumped. But, the seconds resulting from the treatment of such complex sulphides ores still retain the major values, in the shape of all the lead and silver originally present. These are obtained in the coked briquettes in a form eminently adapted for recovery in the subsequent lead smelt. The zinc retained in the seconds does not exceed the amount allowable in ordinary practice, and presents no difficulty in obtaining of the usual bullion recoveries. The residual carbon in the seconds is, of course, a considerable source of heat in the after smelt, and is therefore not lost, as it is in the case of ordinary zinc seconds.

By this simple operation we are enabled to convert a complex ore into a simple silver lead product, amenable to normal reduction methods, having already recovered the bulk of the hitherto objectionable zinc as high quality spelter. The final operation for the recovery of lead and silver as base bullion being the ordinary one, conducted in the usual types of plant, both in South Wales and Australia, does not call for further description here.

Indeed, we may remark that the few operations which constitute our process are all effected in well-known and standard types of plant, and that no fresh item of apparatus, concerning which there might be doubt as to costs or method of working, has been found necessary. Roasting, briquetting, zinc-distilling and lead-smelting methods and costs are fully known. Throughout the operations, nothing beyond coal and binding agent and the usual lead-smelting fluxes are employed. It is somewhat surprising that so simple a method of treatment has been so long overlooked. The system is compact, and permits of economies when zinc and lead-smelting processes are thus linked together, not realisable by either separately.

In general, blende ores containing less than 40 p.c. of zinc are not profitable to treat. Such if mixed with 80 p.c. of anthracite duff would yield pot material containing little more than 22 p.c. of zinc; whereas a zinc-lead concentrate, containing say 35 p.c of zinc, requires, by our process, the addition of only 25 p.c. of mixing coal and binding material, and produces a briquette carrying 28 p.c. of zinc; with the additional advantage of yielding a residue containing profitable material. It is possible to treat a 35 p. c. concentrate for its zinc alone, the lead and silver remaining in the residues as profits subject only to recovery costs, whilst the fuel values remaining aid in reducing these.

Recoveries. Lead, silver, and gold, as before stated, are recovered in the seconds in full, the lead of course is subject to the normal smelting losses, just as in the treatment of ordinary lead concentrates, though the Huntingdon and Heberlein, and Carmichael, processes, claim to reduce such losses to about 2 p.c., and we believe these claims to be well founded.

Bearing in mind the fact that the seconds hold all the lead in the *metallic* condition, the question naturally arose as to whether smelting was the most economical method of recovering this metal and the silver. We devoted considerable attention to the mechanical separation of the reduced lead, but unsuccessfully. The metallic particles and prills are so exceedingly finely divided throughout the carbonaceous sponge that any method of water dressing or concentration results in heavy loss, nor did oil concentration give any better results, owing to the excessive amount of carbon also taken up. On the whole, smelting was adopted as the simplest, safest, and most usual method.

With regard to zinc recovery, the spelter yields are practically the same as those obtained in the ordinary treatment of blende ores. To reckon in percentages is somewhat illusory, as these depend naturally upon the original zinc contents of the ores treated. With a zinc-lead product carrying 40 p c. of zinc no difficulty is experienced in obtaining a recovery of 80 p.c. of that amount, whilst, with a 25 p.c. material, 70 p c. may safely be reckoned upon in modern furnaces. Late advices from Cockle Creek inform us that the recoveries of both lead and silver in the seconds are complete, and that the zinc production already exceeds 70 p.c.; Slimes averaging 25 p.c. of zinc being the raw material used. With 35 p.c. material we have every reason to anticipate an 80 p c. recovery. The pot consumption is quite normal there, mixing coal is obtainable at lower rates than are available to us in South Wales. Fireclay of good quality for the manufacture of hydraulic pressed retorts is also available on the spot; and we have used trial lots of this material for some of our retorts in South Wales, with excellent results. The works at Cockle Creek are the first producers of spelter yet installed in Australia.

In ordinary zinc practice, it is not found economical to force the extraction below a certain point, as the increased time required not only reduces the output of the furnace, but, with the higher temperature necessary, the pot consumption becomes unduly great. The zinc usually left in the seconds varies from about 5 p.c. to 8 p.c. Our working costs are also normal; no difficulty is experienced in calcining the complex ores to the sülphur standard usually required for blende, the zinc furnaces do not demand any greater attention or further hands, whilst labour in retort charging and discharging is materially lightened by the use of briquetted material. Briquetting charges are, of course, additional, but are to some extent balanced by the far smaller consumption of mixing coal, and by the economical handling of material during the final lead smelt.

A point to which attention will doubtless be directed is that of pot and pipe consumption. The average life of our pots, even though used for distilling such highly refractory material, is fully equal to that of the retorts used for good blende and calamine ores according to usual methods, being from five to six weeks each. Our present consumption per day is 3.7 pots per furnace. The cost of our hand-made pots is about 6s. apiece. This is admittedly high, even for England, and hydraulic-pressed retorts, having a longer life, requiring less clay, and demanding a lesser distillation temperature, can be produced for 3s. each.