The average daily consumption was from 17 to 18½ tons, whilst the same vessel when under coal used from 24 to 25 tons.

The economy of cost in liquid fuel does not lie entirely in its superior evaporative value, for several other factors are all in its favour, and probably the greatest of these in the marine service is the reduction in the stokehold staff. Potter states that with fourteen tubular boilers (16 feet × 5 feet) twenty-five men were required for stoking with coal, but on the introduction of liquid fuel six men sufficed. On the s.s. *Murex*, referred to above, whilst more than twenty stokers were required when under coal fires, only three were carried to attend the oil burners. When the cost of wages, food, &c., for the large number of stokers carried on an average liner are taken into consideration, the possibilities for economy by the adoption of liquid fuel, when it can be obtained at a reasonable price, are very great. In the Royal Navy, where the stokers carried on a battleship run into big numbers, not only does liquid fuel tend to economy, but an even more important factor—the number of lives risked in an engagement—would be largely reduced. It is terrible to contemplate the fate of the engine-room staff in the event of one of our big ironclads being sunk by a torpedo or the ram of an adversary's ship.

For storage, liquid fuel has a slight advantage over coal. In general terms it may be said that one ton of liquid fuel will require 36 cubic feet of storage and steam coal from 43 to 45 cubic feet; but it must be remembered that coal bunkers have of necessity to be specially arranged for the easy delivery of the fuel at the stokehold level, whereas liquid fuel may be carried in places where the storage of a solid fuel is quite out of the question. By the adoption of some system of removing water from the oil, such as that of Flannery and Boyd, where two settling tanks are alternately employed, liquid fuel may be stored in water-ballast tanks and the fore and aft peaks of the vessel. Remembering that one ton of oil fuel has such a much larger evaporative efficiency than the same weight of coal, and, further, has advantages in storage, a very much larger cargo space can be reserved in a vessel, or in the case of the belligerent marine, with no greater total weight of fuel on board, a very greatly extended radius of action can be obtained.

A point in connection with coal as a fuel in steamships which is often overlooked is the large amount of inert material which must necessarily be carried in the bunkers; for example, a ship takes into her bunkers 2000 tons of steam coal (*H.M.S. Queen*, which was recently launched, has a coal capacity of 2040 tons), and taking a fair estimate of the ash of this coal at 5 per cent., it means finding space for at least one hundred tons of non-usable mineral matter, even assuming that the ash and clinker do not exceed the ash of the coal. In the case of liquid fuel, the whole amount stored is actually available as fuel, and there is no trouble with ash or clinker in the furnaces, or solid waste of any description to be got rid of.

On any vessel, and especially on a ship carrying passengers, the operation of coaling is a particularly disagreeable one. With liquid fuel there is really no inconvenience, for the oil can be pumped into the tanks in much less time than coal shipment takes, and, further, all the dirt associated with "bunkering" is avoided. At the present time it is well known that the Admiralty is carrying out experiments in coaling war vessels at sea, the collier being made fast astern and the coal hauled along a suitable transport arrangement. It would undoubtedly be a much simpler operation to transfer liquid fuel through a flexible hose of slightly greater length than the cables made fast between the two vessels, providing that an oil of reasonable viscosity was employed.

Even in a country possessing such splendid supplies of steam coal as England, liquid fuel is now making rapid headway, and this is not surprising when one considers the high prices reached for coal of all descriptions during the last two or three years. To be able to fall back on liquid fuel, when it can be obtained at a reasonable price, places the consumer in an independent position as regards the colliery proprietor, and the necessary fittings to enable this to be done are by no means costly. Coal at a fair price will probably always have the advantage over imported liquid fuel, but in countries entirely dependent upon imported fuel, the liquid form must in the future be the main supply, for bulk for bulk it is twice as efficient as any solid fuel, and, moreover, its transport in suitable vessels is attended with far less risk than with coal cargoes shipped from a great distance.

J. S. S. BRAME.

THE MURCHISON FALLS.

THE new Government road from the capital of Uganda to Butiaba on the Albert Nyanza will shortly cause the existing caravan track, which crosses the Nile at Fajao, to be abandoned. The latter place obtained some notoriety during the Uganda mutiny 1897-8, but, not being exactly a health resort, the station was soon after given up, and a few Sudanese of the Uganda Rifles now guard the ferry.

On an isolated mass of rock overlooking the Nile, the European quarters are (or were when I passed through on my way from East Africa to the Sudan in October last) still marked by a couple of thatched huts in dilapidated condition, a flower-garden, and a flag-staff from which fluttered the remains of a "Union Jack." From the station a beautiful view of the Murchison Falls, about a mile distant, can be obtained.

Close to the station are two more isolated masses of biotite gneiss, and undoubtedly the river, which is here confined in a deep cañon, has carved its way eastward for one-and-a-half miles to the present falls, leaving these masses as "witnesses."

On arrival, I was struck by the peculiarly irregular sound of the falls; at night it is especially noticeable.

The track to the falls, used by native fishers, at the foot of the cliffs on the south side, follows close to the water's edge, and the sight of five crocodiles with wide-opened mouths on the opposite shore suggested unpleasant possibilities. Usually crocodiles can be seen in hundreds.

Scrambling along the slippery track, much overgrown in places, and glittering with disintegrated mica flakes, we passed several naked Wanyoro fishers in their canoes, and the decaying remains of fish, chiefly a species of perch, showed their favourite landing places.

Arriving at the 200-foot basin into which the fall takes its final plunge, one notices how the constant spray from the falls, ascending in clouds like steam, allows the luxuriant vegetation to grow over even the vertical cliffs surrounding the basin on three sides, except where the soft mica schist has caved in by weathering. A double rainbow added to the beauty of the scene, but the near view of the falls is distinctly disappointing.

The peculiar intermittent roar could now be accounted for; a mass of water tumbling headlong into the pool is immediately followed by an enormous broken wave, then comes a lull, and the process is repeated.

As this phenomenon was inexplicable from below, I suggested that a climb to the top of the falls was advisable; and after much discussion our Nubi guide extracted from an airily clad Mnyoro the information that a track did exist to the top of the south cliff. It proved to be a most trying 200-foot climb up a steep slope covered with dense grass, and it could only have been made by an energetic European. A short downward scramble led to a rock plateau with potholes, the largest of which was 15 feet in diameter and 10 feet deep, filled with water, marking the level of the former bed of the river when it swirled round a mass of gneiss in its centre. This being gradually worn away on the south side, apparently exposed a softer vein, and the river has cut its way through, in a deep vertical cleft from 20 to 30 feet wide and of unknown depth. A well-known officer in the Uganda Rifles whom I met two days later informed me that he had measured the narrowest portion accessible and found it only 18 feet wide.

Now the Nile above this is a succession of falls, and, after a sharp bend to the north-west, turns again west when 200 feet wide and, gradually narrowing, tumbles 10 feet over a rock ridge spanning the river and then over a 5-foot ridge. For 50 feet it rushes with increasing velocity and finally enters the extraordinary cleft. Down this, for 150 feet, the river "slithers," a solid mass of water, as if through a sluice. Suddenly it meets with an obstruction, a harder layer of gneiss through which it is undercutting its way, and with terrific force strikes this, and rebounds, sometimes with a huge shower of spray. Meanwhile the body of water behind has to find an outlet, and, still confined between high walls, is forced over the ridge with irresistible force ere, 250 feet further on, it tumbles over the last fall into the large basin below, and the back wave, now a vast boiling mass, follows hard after it. This explains the peculiar sound of this fall.

The pent-up power of the Nile as it leaps the barrier is extremely impressive, but from an engineering point of view it is regrettable that such enormous power is running to waste.

I returned to Fajao at sunset, in time to see the Nile tinged a

rich crimson as the sun sank behind the lofty range of mountains west of the Albert Nyanza, and, contrasted with the deep green foliage of the river banks, the scene was striking. But by far the most superb sight was the fall itself under the light of a full moon that night. For the identification of the rock specimens from the falls, consisting of biotite gneiss, mica schist, garnetiferous mica schist, and quartz, I have to thank Mr. G. T. Prior, of the Natural History Section of the British Museum.

C. STEUART BETTON.

THE MANUFACTURE AND USES OF SODIUM.

THE manufacture and uses of metallic sodium is the subject of an interesting article by Mr. James D. Darling in the January number of the *Journal* of the Franklin Institute, from which we take the following facts.

melting point ($800^{\circ}\text{C}.$) of the chloride and to its corrosive action when in the molten state.

The process introduced by Mr. Darling involves the electrolysis of sodium nitrate with the liberation of sodium and of nitrogen peroxide, which is then converted into nitric acid.

The decomposition cell consists of a cast-iron pot set in a brick furnace. At the bottom of the pot is a 6-inch layer of refractory insulating material, and on this rests a cup 30 inches high, 16 inches outside diameter, with walls 4 inches thick. This cup is made of two sheets of perforated steel, between which is a mixture of ground deadburned magnesite and Portland cement which has been mixed with water and allowed to set hard. The space between the cup and the pot is filled with sodium nitrate (M.P. $313^{\circ}\text{C}.$) and the cup itself with melted caustic soda (M.P. $320^{\circ}\text{C}.$). The cast-iron pot acts as the anode, and 5 per cent. of the current is advantageously shunted through the metal walls of the cup. The kathode consists of a short length of 4-inch

FIG. 1.—General View of Sodium Furnaces.

From the time of its isolation in 1801 until 1858, the cost of sodium was exceedingly high. In 1858, Deville perfected the process of manufacture by heating sodium carbonate, chalk and coal in an iron retort and condensing the sodium vapour thus produced. The price then fell from 2000 francs to 10 francs per kilo. No further important advance in the manufacture was made until the late Mr. Castner took up the subject, and after using with great advantage a modification of Deville's process in which carbon was replaced by a compound of carbon and iron and carbonate of soda by caustic soda, he succeeded in 1890 in making Davy's original method available on the large scale, that is to say, the method of decomposing fused caustic soda by the electric current. Most of the sodium used to-day is made by this process.

Attempts to make sodium from its cheapest compound, the chloride, have so far been unsuccessful, owing chiefly to the high

wrought-iron pipe reaching nearly to the bottom of the cup. Each furnace takes a current of about 400 amperes at an average E.M.F. of 15 volts, and external heat is used only when starting up or when changing the cups, which have a life of 425 to 450 hours. When the current is passed, nitrogen peroxide and oxygen are liberated at the anode and escape through a hole in the cover of the pot. Sodium is liberated at the kathode, and rises to the top of the cup, where at intervals of an hour it is dipped off with a spoon and preserved under mineral oil.

The aim of this new process is to decompose sodium nitrate in such a way that the sodium is liberated in a medium which will not oxidise it, and to get the nitrogen peroxide for the manufacture of nitric acid. How this is done will be evident from the description just given; the sodium ions of the fused nitrate travel through the walls of the porous cup to the fused caustic soda; they act upon the caustic soda until it is converted