THE AUSTRALIAN CABLES.

(By W. J. Hancock M.S.T.E.)

The Australian Duplicate Cable line branches off from the Eastern Extension Telegraph Company's extensive system at Singapore. Messages by the old cable go from Singapore to Batavia; and from Batavia across Java to Banjoewangie, thence by a cable which skirts the Islands of Sumbawa, Flores, and Timor, and passes to the South of Sumba or Sandalwood Island.

The 2nd cable goes from Singapore to Banjoewangie direct, and on again to Port Darwin. This cable goes to the north of all these islands, and lies in deep water. The greatest distance between the two cables is off Sunda Island, where they are about 100 miles apart.

The 1st cable was laid by the Eastern Extension Telegraph Co., unsubsidized in 1871, and before the overland Telegraph Line to Port Darwin was finished; the messages being conveyed by horse express over the unfinished portion until the 21st of October 1872, when through telegraphic communication was first established.

The advantage of rapid communication with the rest of the world was found to be so great that when interruptions occasionally occurred, involving loss and inconvenience, the question of duplicating the cable was seriously considered, the result being that a second cable was laid between Singapore and Port Darwin in 1879. by the same company, the colonies of Victoria, South Australia, New South Wales, and Western Australia jointly paying, in proportion to their respective populations, an annual subsidy of £34,400 for a period of 20 years.

The conductor of the 1871 cable consists of seven stranded copper wires, of about No. 20 B.W. guage each; surrounded with several layers of gutta percha composition, forming the insulation. This is again incased in an armour consisting of iron wires, to protect and give the necessary strength to the cable. This is finally wound with hemp and asphalt. The shore ends of the cable are more heavily protected by very much thicker wires. The main cable is about 1in. in diameter, and weighs 3½ tons to the mile, while the shore ends weighs about 11½ tons per mile.

The 1879 cable is very similar, except that an intermediate size of cable is used, as well as the main and shore cable. The shore end of this cable weighs about 10 tons, intermediate 3½, and main 1¼ tons per mile. In this cable between the gutta percha core and the iron wires brass tape is wound as a protection against the attacks of the teredo navalis, a little worm that bores through the gutta percha, thereby destroying the insulation. These cables cost roughly about £100 per mile.

The system adopted for working is not the same as is used for ordinary telegraph lines, in which direct currents are transmitted. The submarine cable is analogous to an immense and attenuated Leyden jar, or condenser, the conductor being the inner, the sheath and water the outer coating, and the gutta percha acting as the glass insulator. Thus the cable, so to speak, holds a charge of electricity, and by varying the amount and polarity of this charge, according to a preconberted arrangement of signals, the messages can be signalled.

The instrument generally used on a long cable is Sir W. Thomson's Syphon Recorder, which consists of a coil of very fine wire, suspended between the poles of two powerful electro-magnets. Through this coil of wire the currents received travel. Fixed to this coil is a very fine glass syphon tube, which conducts the ink from the reservoir to a strip of paper drawn past the end of the glass tube at a uniform speed. Thus this glass pen records every movement of the coil to right or left. The suspended coil and tube will be attracted towards one electro-magnet, or the other according to the polarity and strength of the current received. Thus, it will be easily understood how a code of signals can be made to represent the alphabet, as in the International Code, letters are represented by movements of the coil and glass tube, which are recorded on the paper strip. Thus, A is represented by one movement to right and one to left. B one to the right three to the left; C, one right one left, one right one left, and so on.

The speed of the instrument on the newest cables is about 18 words of 5 letters each per minute, but when worked duplex the rate is about doubled. Cable working is slow compared with the ordinary telegraph, which varies from 25 to 40 words when worked by hand, to from 200 to 1000 per minute in various rapid automatic machines.

When a cable is broken one way of finding the distance of the break is approximately as follows:—The resistance which the entire length of the conductor of the cable offers to the passage of the electric current is known, and tests are usually taken each

known, and tests are usually taken each morning before work. The unit of resistance is called the "Ohm." Thus the resistance of the 1879 cable is about 13,000 ohms, or about 11½ ohms per mile, in good condition. When the cable is broken and the inside conductor exposed, the current has not got to travel the entire length, but only as far as the break, and back by the iron sheathing and water, the resistance of which is taken as nil. The resistance is now much less, and from the testing instrument the number of ohms can be found, and as so many miles go to 1 ohm the number of miles distance of the fault is calculated. The matter is, however, not so simple as various circumstances occur which interfere with the result. For instance, a small portion of the conductor may be exposed, a local current set up between the copper and iron wires in the sea water, polarisation, and other troubles.

To fish up the cable, a grapnel and stout wire rope is used, the steamer going, slowly across the line of the cable, until it is caught, when it is hauled on board, examined, and repaired.

The course of telegraphic messages from Perth to London is as follows :—

	Miles of land line.	Miles of Cable.	Total.
Perth-Albany	261	...	261
Albany-Eucla	762	...	752
Eucla-Port Augusta	759	...	759
Port Augusta-Alice Springs ...	1036	...	1036
Alice Springs-Port Darwin ...	898	...	898
Port Darwin-Banjoewangie ...	...	1150	1150
Banjoewangie-Batavia	480		480
Batavia-Singapore		553	553
Singapore-Penang	...	399	399
Penang-Madras ...	...	1280	1280
Madras-Bombay	650	...	650
Bombay-Aden ...	...	1662	1662
Aden-Suez ...	...	1346	1346
Suez-Alexandria...	224	...	224
Alexandria-Malta	...	828	828
Malta-Gibraltar	...	1008	1008
Gibraltar-Falmouth	...	1061	1061
Falmouth-London	350	...	350
	5,410	9,287	14,697

In the event of interruption of the cable connections at certain points of the regulated route, messages can be sent by way of Penang or Rangoon, or via Saigon, Bankok, and Tavoy (Burmah), or by the Indo-European Company's system, through Russia and across Europe, or by the Great Northern Company's system, across Siberia. This last route is as follows :—

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	Miles.
Singapore to Hong Kong ...	1876
Hong Kong to Shanghai ...	1265
Shanghai to Posiett Bay, Siberia	1330
Across Siberia and Russia, to Lieban Baltic	6394
Lieban to New Boggin, England	1656
Total	12,571

The distance by the proposed route across Canada is approximately

Sydney to Vancouver, B. Columbia	8900
Across Canada	3400
Canada to Ireland	2450
Total	14,800

Messrs. Millar Bros. proposed cable from the North-West coast of Australia would be

N.W. coast of Australia to Madras	3500
Madras to London	8409
	11909

This would have the advantage of avoiding the volcanic regions through which both the present cables run.

The break in the cable communication may be caused by some of those violent volcanic disturbances which occur so frequently in the neighbourhood of the Malay Archipelago.

According to the latest test the distance of the break is about 858 miles from Port Darwin on the old line, and on the new cable 898 miles. The Commander of the *Myrmdon* reports that Mount Tomboro is in active eruption. This troublesome volcano is on the north side of Sumbawa Island. To the south of this island lie both the cables, not very far apart. This point is, however, about 900 miles from Port Darwin, and about 200 miles from Banjoewangie. That the old cable was previously defective and the new cable suddenly from some cause failed, thus cutting off all communication, is probably the most reasonable explanation.

If the cables are only broke in one place, a steamer would not take long to pick them up and repair the damage. But if much of the cable has been destroyed by violent disturbance over a considerable area (similar to what occured in 1882 at Krakatoa) new pieces will have to be put in, and unless the cable steamers, (one of which was reported to

cable steamers, (one of which was reported to have been at Shanghai and the other at New Zealand) on their return have sufficient length to repair the damage, or unless a piece of the old cable is cut out, and spliced into the new one, or *vice versa*, some months may elapse before through telegraph communication will be restored.

But it is utterly impossible to foretell how long the break may last, as it depends on the damage, the cause of which we have no means of knowing at present, shut out as we are from the rest of the world.

The present cost of cablegrams from Perth to London is as follows :

Public messages *viq* Europe direct, 9s. 4d. per word of 10 letters ; Cochin China, 12s. 2d. ; Hong Kong and Siberia, 15s. 1d.

During the year 1886, 46,667 messages to and from Australasia passed through the Port Darwin cables, representing £256,527, or an average per message of £5 10s.