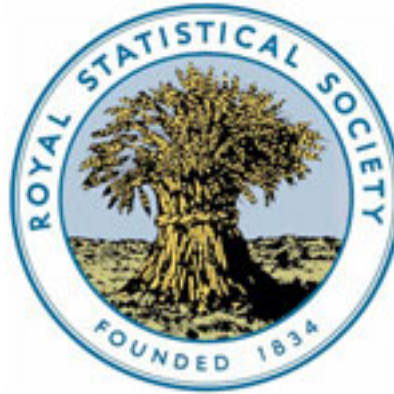


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STATISTICS of TELEGRAPHY. By SIR JAMES ANDERSON.

[Read before the Statistical Society, 18th June, 1872.]

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I PROPOSE in the following pages principally to establish, so far as available statistics will confirm, *first*, the effect of reduced tariffs upon telegraphy, both within the limits and outside the limits of a country, and *second*, to give a statement of all the submarine cables hitherto laid, and to express what, in my opinion, is established by all the experience we have obtained up to the present time.

There is no lack of telegraphic statistics, but they have not all been collected upon any uniform system, one class of telegrams has not been separated from another, and in every country, and with every private company, there has been a varying tariff at irregular intervals, under different political and commercial conditions, which makes the greater part of the statistics of little or no value for the purposes of comparison.

There are, however, sufficient reliable data to establish certain axioms and principles indicating very clearly the results to be anticipated in the future from tariffs or management under either Government or private control.

Belgium and Switzerland for twenty years have enjoyed a telegraphic system under the control of Government, and have been more than any other countries undisturbed by wars, political convulsions or change of superficial area, and, as might have been expected, the most reliable statistics are given by these countries. Add to this the fact that the chiefs of these administrations are men of unusual ability, who have given their undivided attention to the development and improvement of the system under their management, and to the logical statement of the cause and effect produced by any change whatever upon any branch of telegraphy.

We are indebted to Switzerland for the organisation of telegraphic statistics upon a uniform plan, and for originating the International Telegraphic Conventions, which have already been held at Paris, Vienna, and Rome.

I have been so much gratified by the report presented by the Belgian Minister of Public Works, M. Jamar, upon the result of the reductions of tariff from the year 1855 to 1869, that I have translated and produced it in an abridged form and embodied it in this paper, believing that it should be read by every one who cares to understand the subject.

I have read with care the able reports of Mr. Scudamore, the Chief of the Telegraph Administration of the United Kingdom, and I have made free with whatever extracts seemed to bear upon the point I wish to illustrate.

So much has, in fact, been already written by these authorities that I shall probably find it difficult to touch upon many points not covered by them; but, in the case of Belgium, the report is published in French, and not likely to be so extensively known as it ought to be in this country, without being produced in the abridged form, and practically applied to our own system in some such manner as I have attempted.

The reports of Mr. Scudamore have for their object the illustration of the probable effect which would result from the working of the inland telegraphs by the post office, together with a statement of the effect actually produced.

Although I find something about everything connected with telegraphs in reports already published, they are mainly restricted to the operation of internal telegrams, and I cannot well do wrong in freely using the information contained in them which seems to establish any fixed points whatever, either in relation to internal telegraphy or in relation to international telegraphs, the branch in which I am specially interested.

The following table is from Mr. Scudamore's report:—

TABLE I.—*A Statement showing the Total Number of Messages Transmitted, the Revenue Earned, the Working Expenses Incurred, and the Net Produce Earned by the Electric and International Telegraph Company in the Years 1862 and 1866, together with the Proportion of Working Expenses to Revenue, the Number of Messages to each Mile of Wire, the Revenue and Cost per Mile of Wire, and Revenue and Cost per Message in each of the Two Years.*

| | 1862. | 1866. |
|--|-----------|---------------|
| Total number of messages transmitted | 1,534,590 | 3,150,149 |
| Being an increase at the rate of..... | — | 105 per cent. |
| | £ | £ |
| Revenue | 219,441 | 336,458 |
| Being an increase at the rate of..... | — | 53 per cent. |
| Working expenses | 148,609 | 208,739 |
| Being an increase at the rate of..... | — | 40 per cent. |
| Net produce | 70,832 | 127,719 |
| Being an increase at the rate of..... | — | 80 per cent. |

TABLE I.—*Statement showing the Number of Messages Transmitted, &c.—Contd.*

| | 1862. | 1866. |
|--|----------------------|---------------------|
| | Per Cent. | Per Cent. |
| Proportion of working expenses to gross revenue | 67 | 62 |
| „ gross revenue to capital employed..... | 24 | 32 |
| „ net revenue „ | 7 $\frac{1}{2}$ | 12 |
| Number of messages per mile of wire | 44 | 66 |
| | £ s. d. | £ s. d. |
| Gross receipt per mile of wire..... | 6 5 1 | 7 1 5 |
| Working cost „ | 4 4 9 | 4 7 9 |
| Net receipt per mile of wire | 2 - 4 | 2 13 8 |
| Gross receipt per message..... | - 2 10 $\frac{1}{4}$ | - 2 1 $\frac{1}{2}$ |
| Working cost „ | - 1 11 | - 1 3 $\frac{1}{2}$ |
| Net receipt per message | - - 11 $\frac{1}{4}$ | - - 9 $\frac{3}{4}$ |

This table illustrates the effect of lowering the tariff upon the receipts and expenditure of a private company. The tariff was lowered several times upon different sections during this period, but it is not pretended that this was the sole cause of the increase of traffic, a part must be attributable to extensions of accommodation, and a part due to the growth of population and trade. But these facts remain, as the result of lowering the tariff:—

A. That while their business has increased at the rate of 105 per cent. their working expenses have increased at the rate of 40 per cent. only.

B. That though the work done by each mile of wire was greater by 50 per cent. in 1866 than in 1862, the cost per mile of wire was higher in 1866 by only 3 $\frac{1}{2}$ per cent.

C. That though in 1866 their net produce per message was less by 1 $\frac{1}{2}$ d. than it was in 1862, their total net produce was greater by 80 per cent. in 1866 than in 1862.

But it will be instructive at this point to compare this actual result with that which would have been obtained had the high tariff of 1862 been maintained.

In the following statement the estimated number of messages is arrived at by taking the mean increase in the number of messages from 1859 to 1862, the year when the tariff was reduced. (Table XXIV.)

The gross revenue is the amount of 2,726,264 messages, at 2s. 10 $\frac{1}{4}$ d., which is the gross receipt per message in 1862.

The working expenses are the actual figures for the year 1866, and it is certain they would have been considerably less had all the

conditions remained the same as in 1862, with no further extensions, and only the normal development of traffic at the high tariff to provide for.

TABLE II.—*The Electric and International Telegraph Company. Comparison of Actual Profits for the Year 1866, with the Estimated Profits had the Tariff of 1862 continued in Force to that Date.*

| | Actual. | Estimate. |
|---|---------------|----------------|
| Total number of messages | 3,150,149 | 2,726,264 |
| Gross revenue..... | £ 336,458 | £ 389,843 |
| Working expenses | 208,739 | 208,739 |
| Net profit | 127,719 | 181,104 |
| Proportion of working expenses to gross revenue.... | Per Cent. 62 | Per Cent. 53 |
| „ gross revenue to capital employed.... | 32 | 37 |
| „ net „ „ | 12 | 17 |
| Gross receipt per message | s. 2 d. 1½ | s. 2 d. 10¼ |
| Working cost „ | 1 3¾ | 1 6¼ |
| Net receipt per message | — 9¾ | 1 4 |

We see, then, that had the high tariff been maintained the company would have earned an addition at least of 53,000*l.*, or a dividend of 17 per cent. net instead of 12 per cent. upon the capital employed.

It cannot be disputed that the public is better served by a low tariff and increased facilities, and that within certain limits this policy may be remunerative even to a private company. But it will be found throughout these pages to be equally indisputable that the highest return upon the capital invested will be obtained from a high tariff, and that the policy of a private company must always be to guard against unproductive extensions or facilities to the public, lest the capital be seriously increased and the company finds itself attacked when thus burdened upon the productive sections only by a new company with small capital, and the benefit of experience gained at the cost of others.

We find the companies in correspondence with the post office suggesting monopoly as a condition of further extensions and reduction of tariff. But Mr. Scudamore justly characterised this as “*creating a monopoly to earn dividends, instead of creating a monopoly to establish a self-supporting system for the benefit of the public.*” And in support of this latter object the report of July, 1866, com-

compares the progress made by the private companies in England with that made by the telegraphs under the control of the Belgian Government, in substance as follows :—

The companies had increased their wires to the extent of 39 per cent. only.

Belgium had increased theirs to the extent of 107 per cent.

The companies had increased their stations 33 per cent.

The Belgium Government had increased their stations 81 per cent.

By the combined operation of a reduced tariff and increased accommodation, Belgium had increased their inland messages at the rate of 557 per cent., although *the increase upon all kinds of messages* was only at the rate of 286 per cent.

In the same period the messages of all kinds transmitted by the telegraph companies of the United Kingdom have increased at the rate of 123 per cent. only.

Belgium transacted in 1866, on a system twice as great as it was in 1862, a business four times that of 1862, *and their working expenses were only twice as great for this quadrupled increase.*

The amount of their business on each mile of wire was greater by 86 per cent. in 1866 than in 1862, yet the cost to them of each mile of wire was somewhat lower in 1866 than in 1862. Their net revenue was lower than in 1862, *because they had aimed only at creating a self-supporting service*, and yet in 1866 they had a net revenue equal to $12\frac{1}{2}$ per cent. of their gross revenue.

Further, the report states, that under the *régime* of the Companies, the towns in the United Kingdom having a population exceeding 2,000 were served as follows :—

| | | |
|----|-----------|-----------------------|
| 30 | per cent. | well served, |
| 40 | „ | indifferently served, |
| 12 | „ | badly served, |
| 18 | „ | not served at all, |

these latter having an aggregate population exceeding half-a-million inhabitants.

By this process of reasoning, Mr. Scudamore established the conviction that the post office could so work the telegraph service of the United Kingdom as to produce a considerable profit, and yield immense advantages to the public, and he supported his arguments and the fitness of his department for this duty, by the results which it had effected in the money order system and the management of the post office savings bank, together with the enormous increase of postal communication.

Briefly stated, the annual distribution of letters had received an augmentation of 127 millions.

The distribution by the book post had proportionately increased. The pattern post had been established, and made rapid progress.

The registered letters had increased 50 per cent.

The money order system had extended to the colonies, and the gross amount of money orders within the United Kingdom had risen from 13,800,000*l.* to 18,100,000*l.* per annum.

And he showed that the post office could bring to the performance of this new telegraph business 12,000 offices distributed equally, with regard to population, all over the kingdom.

“ Thus bringing the telegraphs closer to the population.

“ Extending the hours during which they could be used daily.

“ Reducing the charges for the transmission of telegrams.

“ And giving the facilities for the transmission of money orders by telegraph.”

The result will demonstrate that, in all these anticipations, Mr. Scudamore had reasoned justly, and he gave the following reasons to illustrate the impossibility of private companies carrying out the desired improvement.

The unavoidable accompaniments to private and joint-stock enterprise produce a series of obstacles to cheapness and progress that only Government control can overcome.

Rival companies did not supply additional facilities to the general public, but only increased the number of competing lines and offices in the same centres of populous towns, which could have been as efficiently served by one company.

The fact that two out of four of the companies must either have been run off the field or forced to amalgamate with the other two, did not improve the condition.

The capital was sunk, and the effect of amalgamation would be to induce the directors to preserve the high tariff, and restrict all further extensions, so as to preserve good dividends with a large reserve.

There were 2,000 miles of wire and 350 offices in excess of the number of either required to do the same work. There were four boards of directors and four sets of leading officials, such as managers, secretaries, engineers, and clerks, striving to make the largest possible return upon the least possible capital, and carrying on a wasteful competition without any benefit to the public.

It was obvious to Mr. Scudamore that this divided management and rivalry was sufficient to account for the feeble growth of telegraphs within the United Kingdom, and that so long as private companies considered it a condition of their existence to do their utmost to procure dividends and to avoid every extension which might prove unproductive, or try experiments with tariffs which might prove disastrous, there could be no hope of the grand development in

telegraphy which had become a feature in several of the continental nations.

When it was first proposed that the Government should purchase the inland telegraph, Mr. Scudamore anticipated that the total cost would be for the whole scheme fully mounted 2,500,000*l*.

But submarine cables and many important extensions, not previously contemplated, besides the higher value awarded to the companies by the arbitrators for the sale of their plant, swelled the capital to the large sum of 7,500,000*l*.

The revenue anticipated, was per annum, 673,838*l*., which for fourteen months, the period the last published report gives for comparison; equals, 786,000*l*.

The actual gross revenue for the fourteen months ending 31st March, 1871, 798,580*l*., or more than 10 per cent. upon the capital.

The working expenses were anticipated to be 360,000*l*. per annum, which for fourteen months gives 420,000*l*.

The actual working expenses were certain not to exceed for the fourteen months, 470,000*l*., about 58 per cent. of the revenue.

The balance of net profit is, therefore, more than sufficient to cover the charge for interest on capital.

The result showing $3\frac{3}{4}$ per cent. per annum on the money invested.

The reduction of the tariff has given to the public, upon the number of messages transmitted, a clear benefit of 300,000*l*., and 4,211 stations have been opened and gradually brought into use from the date of the transfer of the telegraphs to the post office to 31st May, 1871.

The number of offices belonging to private companies was about 1,500.

Mr. Scudamore predicted that even in the first year of the working of the telegraphs *with undivided management*, they would very nearly, if not actually, obtain the estimated gross annual revenue.

That this gross annual revenue must inevitably grow from year to year.

That the estimated nominal proportion of expenditure to revenue, about 58 per cent. would not be exceeded, and throughout his estimates and report he recognises the full value of the following principles:—

That nothing is more certain than the augmentation of business from the increase of facilities, the increase of speed, the accuracy of messages, and the certainty in the public mind that the transmission and reply can be relied upon within a given time.

The following statement proves the accuracy of the anticipated augmentation:—

TABLE III.—*Statement showing Total Number of Messages from 5th February, 1870, to 4th February, 1871, compared with the following Year.*

| Total Number of Messages Forwarded, 1870 to 1871. | Total Number of Messages Forwarded, 1871 to 1872. | Increase. | Average Daily Increase. |
|---|---|-----------|-------------------------|
| 9,486,240 | 12,108,855 | 2,622,615 | 7,185 |

We can rely, therefore, upon seeing in Mr. Scudamore's next report, besides an illustration of his great ability at organisation, the telegraphic correspondence augmented to a point which will appear fabulous, and be likely to convince those who have not contemplated the growth of this class of correspondence, that we are far from seeing the limit or grasping the full effect of this method of transmitting thought. Throughout these reports there has been no attempt to divide the inland, international, and transit telegrams from each other, nor was this subdivision needed for their purpose; but we shall see presently that there is an important difference between them.

I will now show what Belgium has established by twenty years' experience under Government control, and a study of telegraphic statistics more systematic and complete than has been possible with any other country.

I have translated and abridged that part of the report which may properly be termed "A STUDY OF THE THEORETICAL AND "PRACTICAL EFFECT OF TARIFFS UPON ALL BRANCHES OF TELEGRAPHIC "CORRESPONDENCE."

The report is signed by A. Jamar, Minister of Public Works, and will be found in its extended form, with appendixes demonstrating the principles of the tables in vol. xxviii of the "Annals "of the Public Works of Belgium."

It begins with the statement that the tax of half-a-franc for telegrams within the State is a point beyond which no one would dream of further reduction.

But it is only one-half of the tariff charged for international messages, and the same difference exists in the *régime* of neighbouring countries.

At first sight this apparent anomaly suggests the logical propriety of international tariffs being composed of the sum of the internal tariffs.

A statement of the motives for maintaining a higher tariff for international telegrams demonstrates the following principles :—

1st. That in Belgium, notwithstanding the existence of the most favourable circumstances, *all reduction of tariff has resulted in a diminution of the net product.*

2nd. That in the interior service the diminution of net product has been of small importance, and has been accompanied by an immense development of correspondence, that is to say, of service rendered to the public.

3rd. That in the international relations the reduction of the tariff has resulted in a considerable loss, with a much less development of correspondence, as compared with the internal service, that is to say, less service rendered to the public.

Thus the Government is justified before all in reducing the tariff upon inland telegrams, and in deferring the reduction of the international tariff until the increase of traffic overtakes the deficit in revenue caused by the reduction.

These deductions have never been refuted, and carry with them mathematical proofs in support of the resolution formulated in the following terms at the Telegraphic Conference held at Vienna, 7th July, 1868.

“*Il n'existe aucune corrélation entre les taxes intérieures et les taxes internationales.*”

TABLE IV gives the *Total Product and Expenses of the Telegraphic Service since its Origin, until the 31st December, 1869.*

[In this condensed report the centimes are omitted.]

| Dates. | Gross Receipts. | Annual Expenses, Staff and Maintenance. | Net Products. |
|---|-----------------|--|---------------|
| | frs. | frs. | frs. |
| 1850 to 1851 | 88,675 | 59,116 | 29,559 |
| '52..... | 165,974 | 56,163 | 109,811 |
| '53..... | 265,536 | 69,706 | 195,830 |
| '54..... | 280,846 | 89,796 | 191,049 |
| '55..... | 265,940 | 111,500 | 154,440 |
| '56..... | 359,580 | 132,289 | 227,291 |
| '57..... | 407,012 | 177,673 | 229,339 |
| '58..... | 413,926 | 219,391 | 194,535 |
| '59..... | 506,006 | 265,294 | 240,713 |
| 1860..... | 527,744 | 332,501 | 195,243 |
| '61..... | 588,533 | 363,261 | 225,271 |
| '62..... | 605,045 | 405,300 | 199,745 |
| '63..... | 612,363 | 469,427 | 142,937 |
| '64..... | 789,399 | 553,118 | 236,281 |
| '65..... | 865,640 | 660,700 | 204,940 |
| '66..... | 962,213 | 836,959 | 125,254 |
| '67..... | 1,071,468 | 977,680 | 93,788 |
| '68..... | 1,197,102 | 1,185,483 | 11,619 |
| '69* | 1,322,771 | 1,298,915 | 23,856 |
| Totals | 11,295,773 | 8,264,272 | 3,031,501 |
| Total of expenses for construction, acquisition, and extension of the system | | | 2,449,657 |
| Surplus of receipts over expenses of all kinds for the whole period of twenty years | | | 581,844 |

* The receipts and expenses for 1869 are not exactly known. The figures for this year are given approximately.

This table shows that the receipts have always sufficed to cover the expenditure, both of *personnel* and maintenance, and even to provide the capital required for the construction and extension of new lines, and their furnishing with all requisite appliances.

In supposing what is approximately exact, that the expense of establishing the lines at first has followed gradually upon the augmentation of the receipts, it can be admitted that the Government has received interest for the money expended, and now finds itself in possession of the whole telegraphic system without any charge upon the public treasury, and with a surplus of 581,844 frs.

The annual expenses consist of salaries of the *personnel*, maintenance of the lines, instruments and accessories.

These can be considered as forming approximately the equivalent of the expenses of private companies.

The last column of Table IV shows a rapid decrease of net product to a very low point in 1868, when it begins to recover.

The influence the modifications of tariff have had in producing this result requires to be carefully considered.

Telegraphic correspondence develops in virtue of the following causes :—

(a.) The augmentation of the number of offices, both for internal and foreign traffic, giving the utmost facility of access to the use of this means of correspondence.

(b.) The public become habituated to the use of the telegraph ; and it passes gradually from the exclusive domain of important affairs to every day transactions, and to relations purely social and private.

(c.) Lastly. The lowering of the tariff, in placing the facilities of telegraphy within the reach of the greatest number, gives to the movement an impulse in proportion to the importance of each reform.

The two first causes act in a manner very regular ; modified, however, by political and commercial circumstances, and these circumstances modify equally the first effects of the reform of tariff.

The annual expenses follow on their side an ascending progression, influenced by the following conditions :—

(d.) The increase in the number of offices ; the accession of new localities relatively unproductive ; the improvement of instruments ; increase of salaries, and, in general, all measures inevitable or favourable to the public, which do not directly lead to any increase of traffic.

(e.) The regular development of the means of correspondence, instruments, new wires, clerks, messengers, &c., &c., consequent

upon the gradual augmentation of the movement under the causes *a.* and *b.*

(*f.*) Lastly. The exceptional development of the means of correspondence to meet the demand consequent upon a reduced tariff, the third cause, *c*, referred to above.

In order to appreciate the result of these reforms it is necessary to eliminate in the series of annual movements the receipts and expenses which correspond to each year, resulting from the causes above named, *c* and *f*; or, in other words, *to calculate what would have been the result if the tariffs had remained unaltered.*

These can only be hypotheses, but the study of facts approach these hypotheses in reality as much as need be required.

In counting for each year the telegrams exchanged in Belgium, both local and foreign, it can be stated that their number follows without change of tariff a geometrical progression varying by reason of the circumstances already referred to. The mean of this progression is an annual increase of 12 per cent. to 13 per cent. during a period of fifteen years, upon the supposition that the tariff had remained the same and the circumstances had continued neither better nor worse.

A *normal* rate of *progression* is assumed equal to the mean for certain years, in which the progression was sometimes more and at other times less.

The first reduction of tariff dates from 1856. Until then the charges were high and regular, generally about 2 frs. 50 c. per zone, &c.

The development of traffic up to this time resulted for the most part from the establishment of telegraphic relationship with new countries, and the establishment of the principal offices in Belgium.

In order, then, to establish a regular law of development, and eliminate the influence of tariffs, it is necessary to take the year 1855 as the point of departure.

Modifications of tariff were frequent events after this period, but none of them affected all the branches of telegraphy at any one time. The normal rate of progression for each year can therefore be based upon the sum of the relations in which the tariff has not been changed.

In other words the effect of reduced tariffs and all exceptional development is eliminated from the years subsequent to 1855, and the assumption maintained that the tariffs and conditions remained unaltered; this gives variations in each year, but establishes an average rate of progression for the fourteen years of $12\frac{1}{2}$ per cent.

This is the only possible mode of valuation, and furnishes the following elements :—

TABLE V.—*Correspondence of Belgian Telegraph Offices of all kinds.*

| Dates. | Number of Telegrams Exchanged. | Rate of Progression. | | Number of Telegrams without Reduction of Tariff. |
|-------------|--------------------------------------|----------------------|---------|--|
| | | Real. | Normal. | |
| 1851 | 12,706 | — | — | 12,706 |
| '52 | 19,910 | 56½ | 56½ | 19,910 |
| '53 | 34,815 | 75 | 75 | 34,815 |
| '54 | 46,211 | 33 | 33 | 46,211 |
| '55 | 52,004 | 12½ | 12½ | 52,004 |
| | | 50½ | 20 | |
| 1856 | 78,237 | — | — | 62,405 |
| '57 | 89,801 | 15 | 0 | 62,405 |
| '58 | 105,767 | 18 | 8 | 67,397 |
| '59 | 149,245 | 41 | 31 | 88,290 |
| '60 | 175,415 | 17½ | 13½ | 100,209 |
| | | 21½ | 15 | |
| 1861 | 213,066 | — | — | 115,240 |
| '62 | 235,209 | 10½ | 9 | 125,612 |
| '63 | 351,003 | 49 | 12 | 140,685 |
| '64 | 449,848 | 28 | 17 | 164,601 |
| '65 | 584,854 | 30 | 13 | 185,999 |
| | | 71 | 14 | |
| 1866 | 999,132 | — | — | 212,039 |
| '67 | 1,156,570 | 16 | 6 | 224,761 |
| '68 | 1,348,737 | 16½ | 6½ | 239,370 |
| '69 | 1,534,413 | 14 | 10½ | 264,504 |
| Totals | 7,636,943 | — | — | 2,219,163 |

Under the reduced tariffs 7,636,943 telegrams have been transmitted in nineteen years.

Whereas only 2,219,163 could have been transmitted (which is *less than one-third*) if the tariff anterior to 1856 had been maintained. This is the most important result of the reform of tariff, even worthy of a great sacrifice.

The normal rate of progression being found, the same progression

for the receipts can be admitted approximately in the hypothesis of the same tariff being maintained.

It is not the same with the expenses. We have seen that there are inevitable causes which increase the expenses (*par. d*), and which are independent of the amount of correspondence.

On the other hand, the influence of the movement *e* and *f* ought not to take effect in proportion to the number of telegrams; in proportion as this number augments, the expense occasioned by this augmentation ought to tend to diminish the cost of the unit of work.

This benefit, resulting from a great quantity of operations, is less in telegraphy than in any industry. Telegrams must be trans-

TABLE VI.—*Table Indicating the Net Annual Products of the Working of Telegraphs Hypothesis of Maintaining the*

| Dates. | 1 | 2 | 3 | 4 | 5 | 6 |
|---------------|--|------------------------|------------------|------------|-----------------------------------|---------------|
| | Receipts and Expenses of Telegraphs in the Kingdom of Belgium from the First Organisation of the Service up to 31st December, 1869. | | | | | |
| | Total Receipts Paid in to the Public Treasury. | | | | Annual Expenses. | Net Products. |
| | Interior Service. | International Service. | Transit Service. | Total. | Expense of Staff and Maintenance. | |
| | frs. | frs. | frs. | frs. | frs. | frs. |
| 1850-51 | 29,824 | 43,462 | 15,387 | 88,674 | 59,116 | 29,558 |
| '52..... | 31,747 | 64,749 | 69,476 | 165,973 | 56,162 | 109,810 |
| '53..... | 46,300 | 96,795 | 122,441 | 265,536 | 69,706 | 195,830 |
| '54..... | 53,025 | 128,352 | 99,468 | 280,845 | 89,796 | 191,049 |
| '55..... | 52,211 | 147,210 | 66,517 | 265,939 | 111,500 | 154,439 |
| 1856..... | 71,286 | 179,663 | 108,630 | 359,579 | 132,288 | 227,291 |
| '57..... | 81,647 | 176,515 | 148,849 | 407,011 | 177,672 | 229,338 |
| '58..... | 89,314 | 187,162 | 137,449 | 413,926 | 219,391 | 194,535 |
| '59..... | 126,297 | 220,032 | 159,676 | 506,006 | 265,293 | 240,712 |
| '60..... | 142,344 | 232,877 | 152,521 | 527,743 | 332,500 | 195,242 |
| 1861..... | 171,225 | 257,748 | 159,558 | 588,532 | 363,261 | 225,271 |
| '62..... | 176,643 | 280,449 | 147,952 | 605,044 | 405,300 | 199,744 |
| '63..... | 211,063 | 277,266 | 124,033 | 612,363 | 469,426 | 142,936 |
| '64..... | 282,591 | 307,956 | 198,850 | 789,399 | 553,118 | 236,281 |
| '65..... | 345,289 | 340,103 | 180,247 | 865,640 | 660,700 | 204,940 |
| 1866..... | 407,532 | 369,900 | 184,780 | 962,213 | 836,958 | 125,254 |
| '67..... | 469,749 | 409,290 | 192,427 | 1,071,468 | 977,680 | 93,787 |
| '68..... | 549,263 | 424,138 | 223,700 | 1,197,102 | 1,185,483 | 11,619 |
| '69..... | 598,739 | 450,576 | 273,454 | 1,322,771 | 1,298,915 | 23,856 |
| Totals | 3,936,097 | 4,594,250 | 2,765,424 | 11,295,773 | 8,264,272 | 3,031,501 |

mitted one by one, and receive minute care. There is, however, in a great quantity, a certain benefit which must be taken into account.

In observing the series of expenses which have actually been produced, we obtain a simple enough comparison between the rate of progression of expenses and that of the augmentation of correspondence.

This comparative resemblance permits us to calculate *what would have been the economy if the total traffic had not been more than tripled by the reduction of the tariff.*

The series of expenses thus corrected figure in col. 12 of the following Table VI.

in Belgium, from Official Summaries; and the Valuation of these Products upon the First Tariffs without Reduction.

| 7 | 8 | 9 | 10 | 11 | 12 | Dates. |
|--|---|---|------------|---|-------------------------------|---------|
| Receipts and Expenses, Calculated upon the Hypothesis of the Maintenance of the Tariff prior to 1856. | | | | | | |
| Rate of Supposed Normal Progression. | Receipts, Supposed, from Interior and International Service. | Receipts from Transit Service, without Modifications. | Total. | Annual Expenses, Supposed. Reduced Cost of Staff and Maintenance. | Net Products, Supposed. | |
| Per cent. | frs. | frs. | frs. | frs. | frs. | |
| — | 73,287 | 15,387 | 88,674 | 59,116 | 29,558 | 1850-51 |
| — | 96,496 | 69,476 | 165,973 | 56,162 | 109,810 | '52 |
| — | 143,095 | 122,441 | 265,536 | 69,706 | 195,830 | '53 |
| — | 181,377 | 99,468 | 280,845 | 89,796 | 191,049 | '54 |
| — | 199,422 | 66,517 | 265,939 | 111,500 | 154,439 | '55 |
| 20 | 239,306 | 108,630 | 347,936 | 118,900 | 229,036 | 1856 |
| 0 | 239,306 | 148,849 | 388,155 | 154,600 | 233,555 | '57 |
| 8 | 258,450 | 137,449 | 395,900 | 187,300 | 208,600 | '58 |
| 31 | 338,570 | 159,676 | 498,246 | 219,300 | 278,946 | '59 |
| 13½ | 384,277 | 152,521 | 536,799 | 275,900 | 260,899 | '60 |
| 15 | 441,919 | 159,558 | 601,478 | 293,400 | 308,078 | 1861 |
| 9 | 481,692 | 147,952 | 629,644 | 327,100 | 302,544 | '62 |
| 12 | 539,495 | 124,033 | 663,528 | 341,000 | 322,528 | '63 |
| 17 | 631,209 | 198,850 | 830,060 | 395,200 | 434,860 | '64 |
| 13 | 713,266 | 180,247 | 893,514 | 455,700 | 437,814 | '65 |
| 14 | 813,123 | 184,780 | 997,904 | 497,400 | 500,504 | 1866 |
| 6 | 861,911 | 192,427 | 1,054,339 | 584,800 | 469,539 | '67 |
| 6½ | 917,935 | 223,700 | 1,141,635 | 731,700 | 409,935 | '68 |
| 10½ | 1,014,318 | 273,454 | 1,287,773 | 785,700 | 502,073 | '69 |
| — | 8,568,463 | 2,765,424 | 11,333,888 | 5,754,281 | 5,579,606 | |

Cols. 2 to 6 show the receipts, expenses, and net products of the nineteen years such as they have been already given, but this table separates the interior telegrams from the international and transit service.

Col. 8 contains the receipts of the interior and international service upon the hypothesis of the tariff anterior to 1856 being maintained.

Until 1855 inclusive, the figures in this column are equal to the sum of cols. 1 and 2.

After 1856 each receipt is equal to that of the year preceding, with the addition of so much per cent. as is assumed to have been the rate of normal progression.

This rate is shown in col. 7. Col. 9 gives the receipts for transit telegrams, without modification, and they are added to the figures of the preceding column in order to furnish the complete column of supposed receipts, No. 10.

The supposed expenses in col. 11 being deducted, we obtain in col. 12 the supposed net product.

These products, identical with the real results until 1855, exceed them in 1856, by an insignificant amount, but go on always increasing, not by the increase of the total receipts which remain nearly the same, but by the less rapid progression of the expenses.

The total result since the origin gives us the following comparisons, the differences being spread over the fourteen years since 1856.

The total receipts are raised to 11,295,773 frs. They would have been without reduction of tariff 11,333,888 frs. That is, nearly equal.

The total expense of 8,264,272 frs. would have been reduced to 5,754,281 frs. upon the same hypothesis; and the net product, which has been 3,031,501 frs., would have risen to 5,579,607 frs.

These reductions of tariff have diminished the net product by the amount of 2,548,106 frs., which gives for each of the fourteen years a relative mean deficit of 182,000 frs. = 7,280*l.* per annum.

In calculating by a similar method what part of the expense of construction and extension of lines is attributable to the reduction of tariff, we consider this value to be 678,719 frs. (Report annexed C), that is to say, the capital expended was reduced from 2,449,657 frs. to 1,770,938 frs. Spread over fourteen years there was an average expenditure of 48,480 frs. which carries the annual relative deficit to 230,480 frs.

By this sacrifice there has been transmitted and received in Belgium during fourteen years an increase of 5,417,780 telegrams, or an average of 387,000 more per annum than under the old régime, which would only have given an average of 146,680 per annum during the same period. And it may even be doubted if

this latter increase would have continued under the high tariff which at the present day seems almost prohibitive.

INTERNATIONAL SERVICE CONSIDERED.

In order to complete the comparisons it is necessary to separate the interior from the international service, and take a new point of departure; the year 1860, which precedes the first uniform and reduced charge, gradually introduced by the tariff of 1.50 frs. per zone.

In each of the branches of traffic the number of telegrams and the total receipts are given exactly, but the valuation of the net product can only be obtained by an approximate division of the expenses amongst the several branches of traffic, *internal, international, and transit.*

The same agents, and often the same lines and same apparatus are used for the transmission of all the branches of the service.

The interior service comprises alone *two-thirds of the whole correspondence.* *It is for this service that the greater part of the lines are organised.*

All internal telegrams consist of two series of operations, one of departure, the other of arrival.

An international telegram has only one departure or one arrival.

A telegram in transit has only one reception and one re-expedition, without expense of clerk to receive or send by messenger to its destination.

Various methods have been tried to calculate the *units of work and of expense* corresponding to each kind of telegram; between the results obtained there have only been insignificant differences, and the mean is expressed in the most simple and practical manner by the following proportions:—

| | | |
|------------------------------|---|-------------------|
| Interior telegram | 5 | units of expense. |
| International telegram | 3 | „ |
| Transit „ | 2 | „ |

In applying these co-efficients (vide annex D, Belgian report) to the given statistics of the last ten years, we obtain for the price of the interior telegram frs. 2.11, 1.92, and 1.97 respectively for the years 1860, 1861, and 1862. Then when the tariff for 20 words was reduced to 1.50 frs., the expense was reduced to 1.50, 1.35, and 1.27 in 1863, 1864, and 1865. After the first reduction of tariff to 1 fr., the expense fell to 90 c. in 1866, and to 86 c. in 1869, after the final reduction of tariff to 50 c.

The interior traffic produced then a deficit under the new tariff as with the preceding tariffs. We will see further on, *that compen-*

sation is obtained from the international and transit branches of the service.

The annual deficits of the internal service, such as are produced since 1860, can be valued as follows:—

TABLE VII.

| Years. | Number of Telegrams. | Expenses. | | Gross Receipts. | Annual Deficit. |
|------------|----------------------------|------------------|-----------|-----------------|-----------------|
| | | Per Telegram. | Total. | | |
| | | frs. c. | frs. | frs. | frs. |
| 1860..... | 80,216 | 2 11 | 169,260 | 142,345 | 26,915 |
| 1861..... | 97,945 | 1 92 | 188,050 | 171,226 | 16,824 |
| '62..... | 105,274 | 1 97 | 207,390 | 176,643 | 30,747 |
| '63..... | 188,825 | 1 50 | 283,240 | 211,064 | 72,176 |
| '64..... | 252,301 | 1 35 | 340,610 | 282,592 | 58,018 |
| '65..... | 332,721 | 1 27 | 422,560 | 345,289 | 77,271 |
| 1866..... | 692,536 | — 90 | 623,280 | 407,532 | 215,748 |
| '67..... | 817,652 | — 91 | 744,060 | 469,749 | 274,310 |
| '68..... | 972,038 | — 92 | 894,270 | 549,263 | 345,007 |
| '69..... | 1,108,737 | — 86 | 953,510 | 598,740 | 354,770 |
| Totals ... | 4,648,245 | 1 04 | 4,826,230 | 3,354,443 | 1,471,786 |

The progression of the annual deficit in the last column, Table VII, does not represent alone the effects of the reductions upon the internal traffic. These reductions in augmenting this movement, enormously *reduced the cost of the unit of work not only for interior but for all classes of correspondence.*

The benefit which international correspondence derives from this result ought for the most part to be carried to the reduction of the deficit debited to the interior service. This will be seen further on.

In the sequence of the cost of these ten years we see at first the mean of 1860 and 1861 maintain itself, rising a little in 1862. There was, in fact, during these three years, only a partial reduction of tariff applied to a small part of the traffic.

In 1863 the interior tariff is lowered from 1.50 frs. to 1 fr., and the cost is diminished one quarter. From this year the cost diminishes slightly until 1865, also in consequence of partial reforms in the international relations; but in 1866 a sudden decrease in the cost of working takes place, due to the last reduction of tariff for the interior, after which the mean is maintained with very little variation.

We ought then to admit that if all the tariffs were maintained the cost of working would remain the same, the inevitable increase of expenses being compensated by the economies which would result from the normal progression of the movement.

These points established, we can reconstitute approximately the traffic of the ten years such as it would have been under the tariffs of 1860, supposed to be maintained with both international and internal telegrams, a supposition which has already been applied to the whole of the operations. Table VI.

The progression, the receipts, and the expense of the interior service remain for the years 1860, 1861, and 1862 what they were in reality.

After 1st January, 1863, the date of the reduction of the tariff to 1 fr. from 1.50 frs., the progression and the receipts will be regulated by the normal rate which has already been established as the basis of comparison.

The expense of the interior telegrams will be maintained at 2 frs. per telegram, the exact mean of the price given, Table VII, for 1860 to 1862 inclusive.

These valuations are embraced in the following Tables, VIII, IX, and X.

TABLE VIII.—*Interior Traffic.*

| Years. | Estimated Traffic, without the Reduction of Rates. | | | Estimated Annual Expenses. | Estimated Annual Deficits. | Excess of Real Deficits upon Estimated Deficits. |
|------------|--|---------------------|-----------|----------------------------|----------------------------|--|
| | Rates of Progression. | Number of Messages. | Receipts. | | | |
| | | | frs. | frs. | frs. | frs. |
| 1860..... | — | 80,216 | 142,345 | 169,260 | 26,915 | — |
| 1861..... | — | 97,945 | 171,226 | 188,050 | 16,824 | — |
| '62..... | — | 105,274 | 176,643 | 207,390 | 30,747 | — |
| '63..... | 12 | 117,910 | 197,840 | 235,820 | 37,980 | 34,196 |
| '64..... | 17 | 137,957 | 231,470 | 275,900 | 44,430 | 13,588 |
| '65..... | 13 | 155,880 | 261,560 | 311,760 | 50,200 | 27,071 |
| 1866..... | 14 | 177,700 | 298,180 | 355,400 | 57,220 | 158,528 |
| '67..... | 6 | 188,360 | 316,070 | 376,720 | 60,650 | 213,660 |
| '68..... | 6½ | 200,500 | 336,610 | 401,000 | 64,390 | 280,617 |
| '69..... | 10½ | 221,550 | 371,950 | 443,100 | 71,150 | 283,620 |
| Totals.... | — | 1,483,292 | 2,503,894 | 2,964,400 | 460,506 | 1,011,280 |

We see that under the tariff of 1860 the interior telegraphy would have continued to produce an always-increasing deficit.

In order to appreciate the loss by the application of reduced tariffs, it is necessary to deduct from the loss placed to the debit of the interior service the amount gained by the international and transit services, in consequence of the reduced rate augmenting the number of interior messages, thereby reducing the cost of working upon all classes of messages.

Tables IX and X give these amounts :—

TABLE IX.—*International Traffic.*

| 1 Years. | 2 Number of Messages. | 3 Gross Receipts. | 4 5 Expenses. | | 6 Direct Profits. | 7 8 Estimated Expenses. | | 9 Reduced Profits. | 10 Differ- ences. |
|-------------|--------------------------------|-------------------------|------------------|-----------|-------------------------|----------------------------|-----------|--------------------------|-------------------------|
| | | | Per Message. | Total. | | Per Message. | Total. | | |
| | | frs. | f. c. | frs. | frs. | f. c. | frs. | frs. | frs. |
| 1860.... | 95,199 | 232,877 | 1 27 | 120,900 | 111,977 | 1 27 | 120,900 | 111,977 | — |
| 1861.... | 115,121 | 257,748 | 1 15 | 132,390 | 125,358 | 1 15 | 132,390 | 125,358 | — |
| '62.... | 129,935 | 280,449 | 1 18 | 153,320 | 127,129 | 1 18 | 153,320 | 127,129 | — |
| '63.... | 162,178 | 277,266 | — 90 | 145,960 | 131,306 | 1 07 | 173,530 | 103,736 | 27,570 |
| '64.... | 197,547 | 307,956 | — 81 | 160,010 | 147,946 | 1 01 | 199,520 | 108,436 | 39,510 |
| '65.... | 252,133 | 340,104 | — 76 | 191,620 | 148,484 | 1 01 | 254,650 | 85,454 | 63,030 |
| 1866.... | 306,596 | 360,900 | — 54 | 165,560 | 204,340 | — 90 | 275,940 | 93,960 | 110,380 |
| '67.... | 338,918 | 409,291 | — 55 | 186,400 | 222,891 | 1 02 | 345,700 | 63,591 | 159,300 |
| '68.... | 376,699 | 424,139 | — 55 | 207,180 | 216,959 | 1 05 | 395,530 | 28,609 | 188,350 |
| '69.... | 425,676 | 450,577 | — 51 | 217,090 | 233,487 | — 97 | 412,910 | 37,667 | 195,820 |
| Totals | 2,400,002 | 3,350,307 | — 70 | 1,680,430 | 1,669,877 | 1 02 | 2,464,390 | 885,917 | 783,960 |

TABLE X.—*Transmitted Traffic.*

| Years. | Number of Messages. | Gross Receipts. | Expenses. | | Direct Profits. | Estimated Expenses. | | Reduced Profits. | Differ- ences. |
|----------|---------------------------|--------------------|-----------------|---------|--------------------|---------------------|---------|---------------------|-------------------|
| | | | Per Message. | Total. | | Per Message. | Total. | | |
| | | frs. | c. | frs. | frs. | c. | frs. | frs. | frs. |
| 1860.... | 50,404 | 152,522 | 84 | 42,340 | 110,182 | 84 | 42,340 | 110,182 | — |
| 1861.... | 55,902 | 159,559 | 77 | 43,040 | 116,519 | 77 | 43,040 | 116,519 | — |
| '62.... | 56,578 | 147,952 | 79 | 44,700 | 103,252 | 79 | 44,700 | 103,252 | — |
| '63.... | 65,110 | 124,033 | 60 | 39,070 | 84,963 | 71 | 46,230 | 77,803 | 7,160 |
| '64.... | 96,649 | 198,851 | 54 | 52,190 | 146,661 | 67 | 64,750 | 134,101 | 12,560 |
| '65.... | 89,183 | 180,247 | 51 | 45,480 | 134,767 | 67 | 59,750 | 120,497 | 14,270 |
| 1866.... | 128,873 | 184,781 | 36 | 46,390 | 138,391 | 60 | 77,320 | 107,461 | 30,930 |
| '67.... | 132,149 | 192,428 | 36 | 47,570 | 144,858 | 68 | 89,860 | 102,568 | 42,290 |
| '68.... | 153,862 | 223,700 | 37 | 56,930 | 166,770 | 70 | 107,700 | 116,000 | 50,770 |
| '69.... | 188,173 | 273,455 | 34 | 63,980 | 209,475 | 65 | 122,310 | 151,145 | 58,330 |
| Totals | 1,016,883 | 1,837,528 | 47½ | 481,690 | 1,355,833 | 68 | 698,000 | 1,139,528 | 216,310 |

The cols. 1 to 6 present the results of the international and transit traffic, with the profits they have realised after spreading the expense of working such as has been given for the interior service over all classes of telegrams.

Col. 7 gives the series of prices of each telegram upon the hypothesis of the interior tariff being maintained alone. Without the interior reforms the international and transit traffic would not have benefited by the considerable augmentation of the number of units of work, and they would have cost the administration more.

This gives (col. 8) a series of supposed expenses which, deducted from the effective receipts, gives (col. 9) the reduced profit. This latter, deducted from the real profit, leaves (col. 10) *the part of the profit which could not have been realised if the interior reforms had not taken place.*

It is necessary, then, to carry to the credit of the internal service this sum of 783,960 frs., which has been added in seven years to the benefit of the international branch by the reforms of the interior branch, and to this must be added the sum of 216,310 frs., the benefit which the transit service has derived from the same source giving a total of 1,000,270 frs.

This sum will compensate within a few thousand francs the sum found in Table VIII, as representing the direct augmentation of the deficits of the internal service in consequence of the reductions of tariffs.

But, in order to be more exact, it is necessary to consider a contrary reaction, that is, the effect produced by the reductions of the international tariffs upon the lowering the unit of expense applied to the internal movement. If these reductions had not taken place we find that the mean return of the price of interior telegrams reproduced in the second column of the following Table XI, conformably to Table VII, would have been a little increased, such as we see it in col. 3. The difference in col. 4 being applied to the real number of interior telegrams indicates how much this part of the traffic owes to the augmentation of correspondence with foreigners resulting from the successive reforms of the international tariff.

TABLE XI.

| Years. | Mean Cost of Internal Telegrams. | | Differences. | Number of Telegrams in the Interior. | Result of the Reduction of International Tariffs. |
|-------------|-------------------------------------|--|--------------|---|--|
| | Actual. | Supposing the International Tariffs Maintained. | | | |
| | frs. c. | frs. c. | c. | | frs. |
| 1863 | 1 50 | 1 55 | 05 | 188,825 | 9,441 |
| '64 | 1 35 | 1 40 | 05 | 252,301 | 12,615 |
| '65 | 1 27 | 1 33 | 06 | 332,721 | 19,963 |
| '66 | — 90 | — 93 | 03 | 692,586 | 20,776 |
| '67 | — 91 | — 94 | 03 | 817,652 | 24,529 |
| '68 | — 92 | — 95 | 03 | 972,088 | 29,161 |
| '69 | — 86 | — 89 | 03 | 1,108,737 | 33,262 |
| Total | — | — | — | — | 149,747 |

This sum being deducted from 1,000,270 frs., there remain 850,523 frs. to deduct from the increased deficit of Table VIII, this leaves 160,757 frs. as the approximate loss in seven years in consequence of all the internal reforms.

Résumé.

In 1862, with a tariff of fr. 1.50 for all Belgium, there were 105,274 telegrams for the interior.

The expense exceeded the receipts by 30,747 frs., and this deficit was destined to increase year by year (see Table VIII), each telegram costing 2 frs., whereas it only received a mean of about 1.70 fr.

The tariff is reduced in 1863 to 1 fr., and to 50 c. in December, 1865.

There followed such a development of correspondence that, in 1869, the number of telegrams exceed *tenfold the number in 1862*.

During the same time the total receipts of the interior, which in 1862 were 176,643 frs., increased to 598,740 frs. in 1869.

The expense follows a progression equally rapid, but the whole cost to the public treasury for the increase of the traffic tenfold in *seven years* remains at 160,757 frs. = 6,430l.

This difference cannot alone explain the diminution of the net product as given in the last column of Table IV; there must be some additional loss upon the international correspondence, and by applying the same series of deductions to this class of traffic as have already been applied to the internal correspondence, we arrive at a further loss of benefit by the reduction of the tariff upon international correspondence.

Table IX indicates the benefits resulting from the division of the expenses in proportion to the work done.

This rises to 1,669,877 frs. for the last ten years.

The following summary indicates what would have been produced in this branch of traffic if the tariff of 1860 had been maintained.

TABLE XII.

| Years. | Estimated International Traffic without the Reduction of Tariffs. | | | Estimated Annual Expenses. | Estimated Annual Profits. | Actual Net Receipts, Table IX, Col. 6. | Annual Reduction of Profits. |
|----------|---|---------------------------|-----------------|----------------------------------|---------------------------------|---|---------------------------------------|
| | Rates of Pro- gression. | Number of Messages. | Receipts. | | | | |
| 1860.... | — 15 | 95,199 | frs. 232,877 | frs. 120,900 | frs. 111,977 | frs. 111,977 | frs. — |
| 1861.... | — 9 | 109,480 | 267,810 | 139,040 | 128,770 | 125,358 | 3,412 |
| '62.... | — 12 | 119,330 | 291,910 | 151,550 | 140,360 | 127,129 | 13,231 |
| '63.... | — 17 | 133,650 | 326,940 | 169,740 | 157,200 | 131,306 | 25,894 |
| '64.... | — 13 | 156,370 | 382,520 | 198,590 | 183,930 | 147,946 | 35,984 |
| '65.... | — 14 | 176,700 | 432,250 | 224,410 | 207,840 | 148,484 | 59,356 |
| 1866.... | — 6 | 201,440 | 492,760 | 255,830 | 236,930 | 204,340 | 32,590 |
| '67.... | — 6½ | 213,530 | 522,330 | 271,180 | 251,150 | 222,891 | 28,259 |
| '68.... | — 10½ | 227,410 | 556,280 | 288,810 | 267,470 | 216,959 | 50,511 |
| '69.... | — | 251,290 | 614,690 | 319,140 | 295,550 | 233,487 | 62,063 |
| Totals | — | 1,684,399 | 4,120,367 | 2,139,190 | 1,981,177 | 1,669,877 | 311,300 |

This table assumes the cost of each international telegram to remain as it was in 1860, at 1·27 frs., and to be maintained during the whole ten years; the conditions as to tariff remaining the same for *all branches of traffic*, and the increase of necessary expenses compensating for the advantage of the normal increase of correspondence.

The last column of Table XII does not furnish the exact diminution of the net receipts resulting from the reduction of the international tariffs. This relative loss ought to be augmented by the effect of the reaction produced by the reforms of the interior service (Table IX, last column), and diminished by the favourable effect reciprocally produced by the development of the international correspondence upon the results of the interior service. (Table XI.)

This gives for the last nine years the following losses:—

TABLE XIII.

| Years. | Reduction of Direct Profits (Table XII). | To be Added as the Effect of the Interior Tariff (Table IX). | To be Deducted as the Effect of the International Tariff (Table XI). | Balance Due to the International Traffic. |
|-------------|--|---|---|--|
| | frs. | frs. | frs. | frs. |
| 1861 | 3,412 | — | 2,938 | 474 |
| '62 | 13,231 | — | 4,211 | 9,020 |
| '63 | 25,894 | 27,570 | 9,441 | 44,023 |
| '64 | 35,984 | 39,510 | 12,615 | 62,879 |
| '65 | 59,356 | 63,030 | 19,963 | 102,423 |
| 1866 | 32,590 | 110,380 | 20,776 | 122,194 |
| '67 | 28,259 | 159,300 | 24,529 | 163,030 |
| '68 | 50,511 | 188,350 | 29,161 | 209,700 |
| '69 | 62,063 | 195,820 | 33,262 | 224,621 |
| Totals | 311,300 | 783,960 | 156,896 | 938,364 |

We see that there is in the international traffic some diminution in the benefits, which increases relatively to what would have been the result had the tariff of 1860 been maintained, and that these diminutions increase in nine years to 938,364 frs.

This loss, added to 160,757 frs. the loss on the internal service, gives the sum of 1,099,121 frs. to deduct from the net product of the last nine years.

The total of the net profits for 1861 to 1869 inclusive is 1,263,693 frs.

In multiplying by 9, the maximum annual receipts before this period, which was 240,712 frs. in 1859, the product is 2,166,415 frs., and exceeds the real product only by the sum of 902,722 frs. This is, as already said, upon the hypothesis of the nominal progression at the higher tariff equalling only the inevitable increase of expense.

It cannot be doubted that the increase would at least have equalled this amount, and there is every probability that it would have considerably exceeded this, incontestably proving that a diminution of tariff never can produce the same amount of revenue as a higher tariff.

M. Jamar then argues that either his hypothesis exaggerates by one-tenth the losses resulting from the reduction of tariff, or (which is probable) that the net profits would have been the same without any reduction of tariff.

Either alternative can be adopted without altering the value of the following conclusions.

RESULTS FROM THE FOREGOING TABLES.

The net product of the Belgian telegraphic system has been diminishing for several years, and was reduced to a point at which there was scarcely any profit in 1868.

Nine-tenths of this ought to be attributed to the successive reductions of the tariff upon international telegrams, and the remainder to the reduction upon interior telegrams.

It is true that the interior service, considered separately, produced a deficit before the reforms of 1863 and 1865. These reforms have slightly augmented the deficit, but this augmentation is only 160,750 frs. for seven years.

It is equally true that the international service has always given a benefit, but the successive reductions of tariff with foreign countries have reduced this profit 938,300 frs. in nine years as compared with what would have been the result had the tariff of 1860 been maintained.

On this supposition there would have been, from 1863 to 1869 inclusive, 1,199,850 interior telegrams. The reduced tariffs have given 4,364,810; that is, 3,164,960 more in seven years, or 452,006 per annum. For this quadruple movement the public have to pay with the sacrifice of 160,750 frs.

By the same reasoning there have been from 1861 to 1869 inclusive, 1,589,200 telegrams exchanged between Belgium and foreign countries. The reduced tariff has increased this to 2,304,803, an increase of 715,603 in nine years, or 79,510 per annum. This augmentation of 45 per cent. has diminished the receipts by the amount of 938,300 frs.

There is, then, an enormous difference in the results of reduced tariffs upon *internal* correspondence as compared with *external* correspondence, and if we examine separately the effects produced by international relations, even the most intimate, we shall see that the confirmation of this difference is easy to find.

In dividing the telegraphic correspondence according to its nature, we find:—

| | Telegraphic Correspondences. | | |
|---|------------------------------|------------------|-----------------|
| | Interior. | International. | Total. |
| Messages of Governments and of diplomatic offices | $\frac{1}{2}$ | $\frac{3}{4}$ | $\frac{1}{2}$ |
| (Money Market) Stock Exchange, news, &c. | 5 | 12 $\frac{1}{2}$ | 8 $\frac{3}{4}$ |
| Commercial transactions | 34 | 56 $\frac{1}{4}$ | 45 |
| Private and family relations..... | 59 $\frac{1}{2}$ | 28 $\frac{1}{2}$ | 44 |
| Newspaper telegrams | 1 | 2 $\frac{1}{4}$ | 1 $\frac{3}{4}$ |
| | 100 | 100 | 100 |

Contrary to the general supposition, the correspondence of the Government, the affairs of the Bourse and news for the press, far from constituting the principal object of telegrams, are only 11 per

cent. of the total, $6\frac{1}{2}$ per cent. for the interior, and $15\frac{1}{2}$ per cent. for international service.

The lines are occupied nine-tenths of the time by two principal currents. There is a more or less eager demand for the use of the telegraph for commercial affairs, according to the variations of political or financial conditions.

The relations of social and family life gradually become more and more accustomed to the use of the telegraph, owing to the reduction of tariff bringing it within the scope of classes with moderate incomes, and engaged in small transactions.

As may be imagined these two currents of correspondence are not of equal importance within the limits of a country and outside those limits.

Social and family relations are never so numerous outside the frontier of any country.

They are only $28\frac{1}{4}$ per cent. in the international correspondence, while they constitute $59\frac{1}{2}$ per cent. of the internal traffic.

In compensation, however, the commercial telegrams absorb $56\frac{1}{4}$ per cent. of international correspondence, and 34 per cent. only of the interior.

Before the reduction of tariff, the proportion of internal correspondence was the same, but the proportion of commercial correspondence was 63 per cent. of the international movement; more, therefore, than it became with a reduced tariff.

It is thus evident that this class of correspondence follows above all, in its movement, the fluctuations of commerce, and is only influenced in a secondary degree by the alteration of tariff.

And as commercial affairs constitute the principal object of international correspondence, we cannot hope to increase these relations by any tariff cheap enough to augment the correspondence to anything resembling the increase of telegraphy within the State.

The benefit must be much less since there are so few people to profit by it.

It must cost more because no similar augmentation can take place to reduce the the expense of working, such as we see in relation to the internal correspondence.

Résumé.

In summarising under form of principles the result of experience, such as the foregoing pages have analysed, we consider as demonstrated:—

1st. *That a reduction of tariff leads to a diminution of the net product, even under the most favourable conditions known.*

2nd. *That the interior service already producing a deficit before the last reduction of tariff, has obtained by these reductions an enormous*

increase of correspondence, with, however, a slight augmentation of the deficit.

3rd. *That the international service, which has always given a profit, has realised under similar conditions a development of correspondence, much less, and a diminution of benefit much greater than has resulted to the internal service.*

4th. *With the interior correspondence the deficit tends to diminish, while with the international correspondence the diminution of benefit tends to increase.*

From these facts Belgium assumes, that the motives of public interest which determine a reduction of tariff for internal service, are not those generally applicable to the international service; and he suggests that the tariff should be continued unaltered until the natural increase of traffic has swelled the receipts to a sufficient amount to recoup the expenditure.

We will now consider how far the traffic of the different private telegraph companies is affected by the foregoing principles.

ATLANTIC TELEGRAPHY.

There are many and sufficient reasons which render it inexpedient on my part to publish all the details of private companies which are open to me, and have been well considered with the desire to find material of some practical value for this paper.

It must be sufficient for the present to prove that even under the most favourable conditions for *international* telegraphy the world can produce there is no exception to the rule, "That a reduction of tariff leads to a diminution of the net product."

| | £ |
|---|-----------|
| The actual earnings of the Atlantic Telegraph Companies from } 28th July, 1866, to 31st December, 1871, were | 2,171,000 |
| Assuming the tariff to have remained at 12'84 <i>l.</i> (the mean for the } first eleven months), and the traffic to have increased annually } at the rate of 12½ per cent., the gross earnings would have } amounted to | 2,518,000 |
| Difference in favour of 12'84 <i>l.</i> tariff | 347,000 |
| Add—Expenses which would not have been incurred | 97,000 |
| Total | 444,000 |

The Duration of the Different Tariffs was as follows:

| £ | s. | d. | | |
|----|----|----|--|---------------------|
| 20 | — | — | 28th July to 31st October, 1866 | = 3 months 4 days. |
| 10 | — | — | 1st November, 1866, to 30th November, 1867 | „ 1 year 1 month. |
| 5 | 5 | — | 1st December, 1867, to 31st August, 1868 | „ 9 months. |
| 3 | 7 | 6 | 1st September, 1868, to 31st May, 1869 | „ 9 „ |
| 2 | — | — | 1st June, 1869, to 9th August, 1869 | „ 2 months 9 days. |
| 1 | 10 | — | 10th August, 1869, to 11th December, 1870 | „ 1 year 4 months. |
| 3 | — | — | 12th December, 1870, to 30th June, 1871 | „ 6 months 19 days. |
| 2 | — | — | 1st July, 1871, to 31st January, 1872 | „ 7 months. |

The above statement assumes the mean tariff for the first twelve months to be maintained, and $12\frac{1}{2}$ per cent. as the normal rate of increase of traffic for each year, an increase which would only have produced an average of 114 messages per day for the year ending December, 1871, less than one-fourth of the real traffic, and a number so low that no one can suppose it would not have been attained even with the tariff at 20*l.*

Could the high tariff have been maintained one cable would have sufficed for the limited traffic, all the capital and working expenses of the French Atlantic Cable would have been saved, and the Anglo-American Company would now be enjoying 27 per cent. dividend upon a capital of 1,675,000*l.*

If, then, this small number of messages would have yielded a larger revenue than the greater number with the series of reduced tariffs given above, it follows that some other motives than cheapness must prevail to induce any private company to reduce their tariff.

These motives have hitherto been expediency, competition, and the attempt to combine and stave off further opposition; and we shall probably see reproduced the experience of the competing land lines in this country already referred to, "*One or more will be ruined or forced to amalgamate; higher tariffs will be resorted to in order to preserve good dividends with a large reserve, and further extensions will be avoided.*"

| | £ |
|--|------------------|
| We have already three Atlantic cables laid and in good working order, represented by a capital of | 3,675,000 |
| There are two additional cables projected, one to be laid by the French Atlantic Company at a cost of 900,000 <i>l.</i> , and another by the Great Western Telegraph Company, whose capital is 1,350,000 <i>l.</i> , making together | 2,250,000 |
| Total | <u>5,925,000</u> |

The revenue earned by the Atlantic cables, including the Newfoundland Company's proportion, amounted, as far as can be ascertained from the published accounts of the companies for the year 1871, to 610,000*l.* During the first six months of that year a 3*l.* tariff was in force, and during the last six months 2*l.* was charged. Taking the mean rate of 2*l.* 10*s.* we can assume that 245,000 messages were sent.

From existing data we can say that the normal increase of traffic may be estimated at 25 per cent., which would give a total of 306,250 messages for the current year, and 382,812 for 1873.

The effect of lowering the tariff from 2*l.* to 1*l.* will probably be to increase the number of messages 75 per cent. in the first year after the reduction.

As the two new cables cannot be laid until after the lapse of the first six months of next year, we may estimate—

| | £ |
|--|---------------------|
| The number of messages for the June half-year of 1873 at 191,406; } these at a 2 <i>l.</i> tariff will give a revenue of..... | 382,812 |
| Upon the assumption of a 1 <i>l.</i> tariff increasing the traffic 75 per cent., } the number of messages for the second half of 1873 would be } 334,960, and the total revenue for the six months | 334,960 |
| Together | <hr/> 717,772 <hr/> |

Estimating the expenses attending the working of the five cables at 110,000*l.* per annum, the balance of revenue for 1873 would yield upon the gross capital about 10 per cent. for dividend and reserve.

But for 1874, supposing the regular increase of traffic to be 25 per cent. upon the number of messages sent in 1873, the total revenue at a 1*l.* tariff would only be 657,957*l.*, and this less working charges would return on the gross capital 9 per cent. for dividend, reserve, and repairs.

I must, however, state that this is probably the worst view of the case as regards the traffic—what may be required for repairs, and how much wasted upon competition, I need not now consider.

Better results might be shown if the traffic of the last two years were alone referred to, but we cannot always rely upon Alabama disputes and Erie Ring contests; and in calculating the probable results of the next few years, we may reasonably expect that there will be one year at least without much, if any, increase.

There are fluctuations in the commercial world which it would be folly to ignore, and I give the above figures as the minimum which may safely be anticipated; but who can say what the maximum would be if it were sought to establish *only a self-supporting instead of a dividend-earning system.*

We must, however, at once discard all idea of ever making the tariff so low as it is for interior telegrams, the local relations do not exist to any extent requiring an outlay of even 10*s.* for a telegram. No one can order his dinner by telegram. The small tradesmen in the suburbs and provincial towns cannot order their daily or weekly supply of goods by telegram. All the questions of minor importance relating to the inner life of a nation have no equivalent outside the limits of any country.

But still it cannot be disputed that Atlantic telegraphy under a self-supporting tariff, would within ten years require several additional cables. The interchange upon a grand scale of the products of the old and new world. The intimate political relations with this country, possessing as we do a great dominion extending from the Atlantic to the Pacific Ocean Islands, besides islands

so unreliable that there were frequent complaints of letters reaching their destination sooner than telegrams, which were often unintelligible when they did arrive.

The uncertainty of telegrams being sent in their order, or of arriving at all, was loudly complained of, and yet we find a decided tendency to increase.

The year 1867 shows a slight decrease, but it has nothing to do with tariff; there was no change in that.

1868 gives 13·55 per cent. increase, and gross receipts amounting to 208,344*l.*

The tariff is then lowered at the instigation of the Telegraphic Convention, urged upon the principle that the benefit to the public would be very great.

The effect of lowering the tariff from 5*l.* 1*s.* to 2*l.* 17*s.* was to increase the number of messages 34 per cent., and to decrease the gross revenue 32 per cent.

At this point in March, 1870, two efficient telegraph lines were opened from England to India; both of them (with only a few interruptions, never occurring at the same time) have carried this class of correspondence, in popular phrase, "quicker than the sun "itself," and it is acknowledged that this element increases international telegraphy more than any other.

A large part of the increase subsequent to that date must, therefore, be attributed to these new facilities; and as a proof of this, I may relate some efforts made to augment correspondence; we expended thousands of pounds in advertising and in communicating with everyone likely to have any commercial or social relations in the East.

We tried to enlist the press, and gave telegrams of public interest for half price to Mr. Reuter.

We employed boats to go on board every steamer at Gibraltar, Malta, Suez, and Aden, and it is on record, as a matter of experience, that we did not get 2 per cent. of social messages from all our efforts in the first direction named; we found that India could not supply Mr. Reuter with a telegram every day worth publishing. Somebody had gone to the hills, or somebody was leaving Madras and going somewhere else, formed the class of telegrams sent from India, and nobody wanted them, nor did we, by employing boats to visit ships with passengers voyaging to and from all parts of the East, obtain six messages in the six months.

During the great continental war we were eagerly sought to give news to Gibraltar, Malta, Egypt, Aden, and the Mauritius; but as the killed and wounded diminished, the thirst for telegrams subsided, and I do not think they would have given us quarter rates for a daily telegram.

I make these statements as further confirming the principle *that the social relations which exist outside the limits of a country do not give any appreciable addition to telegraphic correspondence*; questions of urgency, for which even 20s. would be expended, are not frequent, and these questions are more apt to be nearer home than several thousand miles away.

It must be accepted as a feature of telegraphic correspondence *that commerce gives at least 90 per cent. of all international telegrams*, where the countries are remote.

Belgium we have seen at the end of my extract gives 63 per cent. for international commercial telegrams before the tariff was lowered, and 56 per cent. after it was lowered, that is more in proportion with a high than with a low tariff, proving that tariff only affects this class of correspondence in a secondary degree.

We find, then, that these new routes to India, the Indo-European, and British-Indian Submarine, increased the correspondence 42 per cent., bringing it up to nearly double the amount it had attained in its best year under the higher tariff of 5*l.* 1*s.*, but this double number of telegrams, "carried quicker than the sun," at a tariff of 2*l.* 17*s.*, only produced 18,000*l.* more than the old slow and unreliable line at the high tariff of 5*l.* 1*s.*

The result of this competition was that the Turkish line was losing upwards of 20,000*l.* per annum, the Indo-European line was not paying, and the British-Indian line was earning a meagre 5 per cent. for the purposes of dividend, reserve, and maintenance.

Early in 1871 the tariff was increased to 4*l.* 10*s.*, and the effect of this increase was not to diminish the traffic, but with the same traffic to increase the revenue 48 per cent.

It may be argued that the increase of tariff stopped the immediate increase of traffic, but that cannot in justice be affirmed. The great continental war suspended many commercial operations, numerous engagements of tonnage and orders for goods were cancelled, and for many months transactions were limited to those bearing the minimum of risk.

The experience, then, of Indian traffic confirms all the foregoing principles, and it follows that, if we are to have a low tariff, calculated to stimulate this class of correspondence, increase commercial activity, and make telegraphy more a habit of the people in India, it must be done at a sacrifice of dividends at least, and these are for the present at as low a point as private investors will encourage.

We propose from the first of next month to reduce the tariff from 4*l.* 10*s.* to 4*l.*, and there is a hope that the traffic will be elastic enough to recoup within the first year the loss from this moderate reduction. Government alone can afford to bring the tariff to 3*l.*, a

tariff which would keep the lines self-supporting, and provide for the extensions which the certain increase of commercial activity from this cause alone would demand.

It should not be lost sight of that, while a very low tariff would unquestionably increase the correspondence considerably, it would also necessitate the addition of more lines, which over so great a distance can never be done without a large expenditure of capital; and as it is proved that this class of correspondence is principally commercial, it must be kept self-supporting at least, even if controlled by Government, or taxpayers may well object to share a burden so specially advantageous to the commercial classes, and only in a secondary degree of general benefit to the whole community, nothing more than a gradual and moderate reduction below 3*l.* for twenty words, even under Government control, could, therefore, be anticipated.

It is proper here to call attention to what India has already done, and what they appear to be sacrificing in the interests of telegraphy.

The following table shows that India, in the year 1869, exchanged fewer telegrams of all kinds than Turkey or Roumania, and very few in excess of Denmark, and taking the statement published by the International Telegraph Office of Berne, as I find it, they appear to lose upon every telegram 4*s.* 6 $\frac{3}{4}$ *d.*

TABLE XIV.—*Statement of the Average Cost, Product, Profit, and Loss per Telegram for 1869.*

| States. | Number of Messages for 1869. | | | | Total Working Expenses for 1869. |
|-----------------------|------------------------------|----------------|----------|-----------|----------------------------------|
| | Internal. | International. | Service. | Total. | |
| | | | | | £ |
| Austria and Hungary | 2,807,958 | 1,281,796 | 146,035 | 4,235,789 | 280,457 |
| Baden | 126,429 | 481,765 | 289,884 | 898,078 | 13,996 |
| Bavaria | 262,649 | 596,056 | — | 858,705 | 21,866 |
| Belgium | 1,108,737 | 613,849 | 315,722 | 2,038,308 | 51,957 |
| Denmark | 186,979 | 222,188 | 10,453 | 419,620 | 18,044 |
| France | 4,729,588 | 1,579,717 | — | 6,309,305 | 413,320 |
| Germany (North) ... | 4,028,764 | 2,168,274 | 69,460 | 6,266,498 | 335,399 |
| Great Britain, India* | 481,824 | 40,852 | — | 522,676 | 264,070 |
| Greece | 96,213 | 13,335 | 3,260 | 112,808 | 15,506 |
| Holland | 949,562 | 682,490 | 11,338 | 1,643,390 | 62,181 |
| Italy | 1,643,147 | 693,809 | 71,407 | 2,407,863 | 158,608 |
| Norway | 266,163 | 140,965 | 21,977 | 429,105 | 26,874 |
| Roumania | 434,590 | 162,450 | 1,076 | 598,116 | 55,007 |
| Russia | 1,886,849 | 391,743 | 120,818 | 2,399,410 | 330,041 |
| Spain | 742,087 | 252,280 | 78,084 | 1,072,451 | 137,001 |
| States of the Church | 40,250 | 68,639 | 2,296 | 111,185 | 5,613 |
| Sweden | 384,128 | 211,833 | 702,551 | 1,298,512 | 40,356 |
| Switzerland | 951,337 | 418,087 | 24,592 | 1,394,016 | 36,924 |
| Turkey | 476,342 | 194,978 | — | 671,320 | 151,163 |

* India—these figures are approximately exact; the financial year terminating in March, all accounts are made up to that date.

TABLE XIV.—*Cost, Product, Profit and Loss per Telegram—Contd.*

| States. | Average Cost per Telegram for 1869. | | Total Receipts for 1869. | Average Product per Telegram for 1869. | | Average Profit per Telegram. | Average Loss per Telegram. |
|-----------------------|-------------------------------------|------------------|--------------------------|--|------------------|------------------------------|----------------------------|
| | <i>s.</i> | <i>d.</i> | £ | <i>s.</i> | <i>d.</i> | <i>s.</i> | <i>d.</i> |
| Austria and Hungary | 1 | 3 $\frac{3}{4}$ | 292,409 | 1 | 4 $\frac{1}{2}$ | — | — |
| Baden | — | 3 $\frac{1}{2}$ | 15,122 | — | 4 | — | — |
| Bavaria | — | 6 | 35,213 | — | 9 $\frac{3}{4}$ | — | — |
| Belgium | — | 6 | 52,943 | — | 6 $\frac{1}{4}$ | — | — |
| Denmark | — | 10 $\frac{1}{4}$ | 16,331 | — | 9 $\frac{1}{4}$ | — | — 1 |
| France | 1 | 3 $\frac{1}{2}$ | 426,264 | 1 | 4 | — | — |
| Germany (North) ... | 1 | — $\frac{3}{4}$ | 307,897 | — | 11 $\frac{3}{4}$ | — | — 1 |
| Great Britain, India* | 10 | 1 $\frac{1}{4}$ | 145,042 | 5 | 6 $\frac{1}{2}$ | — | 4 6 $\frac{3}{4}$ |
| Greece | 2 | 8 $\frac{3}{4}$ | 5,970 | 1 | — $\frac{1}{2}$ | — | 1 8 $\frac{1}{4}$ |
| Holland..... | — | 9 | 46,300 | — | 6 $\frac{3}{4}$ | — | — 2 $\frac{1}{4}$ |
| Italy | 1 | 3 $\frac{3}{4}$ | 188,736 | 1 | 6 $\frac{3}{4}$ | — 3 | — |
| Norway..... | 1 | 3 | 27,601 | 1 | 3 $\frac{1}{4}$ | — | — |
| Roumania..... | 1 | 10 | 41,866 | 1 | 4 $\frac{3}{4}$ | — | — 5 $\frac{1}{4}$ |
| Russia | 2 | 9 | 492,628 | 4 | 1 $\frac{1}{4}$ | 1 4 $\frac{1}{4}$ | — |
| Spain..... | 2 | 6 $\frac{1}{2}$ | 70,639 | 1 | 3 $\frac{3}{4}$ | — | 1 2 $\frac{3}{4}$ |
| States of the Church | 1 | — | 4,712 | — | 10 | — | — 2 |
| Sweden | — | 7 $\frac{1}{4}$ | 49,306 | — | 9 | — 1 $\frac{3}{4}$ | — |
| Switzerland | — | 6 $\frac{1}{4}$ | 42,134 | — | 7 $\frac{1}{4}$ | — 1 | — |
| Turkey | 4 | 6 | 209,601 | 6 | 2 $\frac{3}{4}$ | 1 8 $\frac{3}{4}$ | — |

* India—these figures are approximately exact; the financial year terminating in March, all accounts are made up to that date.

I do not know whether the telegraph department in India credits itself with a charge upon all Government and political telegrams; if not, then the figures given do not in my opinion give full justice to the department. Belgium, Switzerland, and some other countries debit their Government as they do the public; in some cases, however, only at half-rates, but it is obvious that the capital expended upon any system should be credited with whatever benefits it yields, either of service to the State or service to the public.

From this enormous loss, then, there should be deducted some amount representing the sum the country would gladly pay in money for the facilities of governing so vast a territory with 150,000,000 of inhabitants, so much under military control. There will, no doubt, be great sums saved annually in the movement of troops—more concentration, security, and economy entirely indebted to telegraphy, and therefore a direct gain to the State.

But, assuming that the number of telegrams given in the preceding table represent the money-earning telegrams, and therefore

the service rendered to the commercial public, it is at best a beggarly account for so great a territory, and can only be accounted for by the two following causes:—

The uncommercial habits of the people; and

The tariff being so high in relation to the magnitude of the transactions common to the natives, having more resemblance to the amount paid in this country for international telegrams than to the amount common to this and every other nation for internal correspondence.

It is established that a reduction of tariff for interior traffic has, nearly in every instance, produced an enormous increase of traffic, with only a slight increase in the deficit of the net product.

And that this deficit upon internal correspondence tends to diminish.

The statement which follows shows what the telegraphic system has cost the various States, from the earliest to the latest available data, proving that most countries think it worth a considerable sacrifice to obtain a telegraphic communication.

TABLE XV.—*Statement showing the Total Expenses, Receipts, Profit and Loss, and Average Yearly Profit and Loss, from Commencement of Lines to 1869.*

| States. | Date from | Expenses. | | | Receipts. | Loss. | | Profit. | |
|-----------------------|-----------|------------------|------------------------|----------------|-------------|----------------|-----------------|----------------|-----------------|
| | | Working to 1869. | Establishment to 1869. | Total to 1869. | | Total to 1869. | Average Yearly. | Total to 1869. | Average Yearly. |
| Austria and Hungary } | 1849 | £ 2,691,744 | £ 850,477 | £ 3,542,221 | £ 2,855,671 | £ 686,550 | £ 32,692 | — | — |
| Baden | '51 | 125,296 | 40,790 | 166,086 | 133,606 | 32,480 | 1,709 | — | — |
| Bavaria | '51 | 292,636 | 142,253 | 434,889 | 348,525 | 86,364 | 4,478 | — | — |
| Belgium | '50 | 330,562 | 97,186 | 427,748 | 451,863 | — | — | 24,115 | 1,204 |
| Denmark | '54 | 217,496 | 137,665 | 355,161 | 248,688 | 106,462 | 6,653 | — | — |
| Germany (North) } | '49 | 2,198,785 | 759,674 | 2,958,459 | 2,532,409 | 426,049 | 20,288 | — | — |
| Holland | '52 | 472,164 | 193,658 | 665,822 | 489,965 | 175,897 | 9,772 | — | — |
| Italy | '62 | 1,402,214 | 104,056 | 1,506,270 | 1,265,386 | 240,884 | 30,110 | — | — |
| Norway | '55 | 257,462 | 184,859 | 442,321 | 213,718 | 228,603 | 15,240 | — | — |
| Russia | '56 | 2,769,442 | 1,064,425 | 3,833,867 | 3,116,750 | 717,157 | 51,222 | — | — |
| Spain | '55 | 1,787,988 | 195,358 | 1,983,346 | 724,554 | 1,258,792 | 83,919 | — | — |
| Sweden | '53 | 416,828 | 268,324 | 685,152 | 717,143 | — | — | 31,991 | 1,881 |
| Switzerland.... | '52 | 320,138 | 66,741 | 386,879 | 393,144 | — | — | 6,265 | 348 |

TABLE XVI.—*Statement showing the Total Number of Telegrams from the Opening of the Lines.*

| States. | 1849. | 1850. | 1851. | 1852. | 1853. | 1854. |
|---------------------------|-------|--------|--------|--------|---------|---------|
| Austria and Hungary | 8,593 | 14,398 | 56,164 | 84,888 | 146,560 | 231,165 |
| Baden | — | — | 4,148 | 12,460 | 37,591 | 41,346 |
| Bavaria | — | 2,404 | 6,228 | 15,527 | 24,726 | 61,117 |
| Belgium | — | — | 19,686 | 41,509 | 76,312 | 95,096 |
| Denmark | — | — | — | — | — | 20,043 |
| France | — | — | 9,014 | 48,105 | 142,061 | 236,018 |
| Germany | — | 35,494 | 40,065 | 48,751 | 85,161 | 115,481 |
| Holland..... | — | — | — | 1,369 | 45,738 | 104,655 |
| Norway..... | — | — | — | — | — | 1,858 |
| States of the Church | — | — | — | — | 173 | 730 |
| Sweden | — | — | — | — | 851 | 10,534 |
| Switzerland | — | — | — | 2,876 | 84,832 | 132,340 |
| Wurtemberg | — | — | — | — | 41,385 | 40,112 |

| States. | 1855. | 1856. | 1857. | 1858. | 1859. |
|---------------------------|---------|---------|---------|---------|---------|
| Austria and Hungary | 269,504 | 342,526 | 396,503 | 463,950 | 728,219 |
| Baden | 51,067 | 67,304 | 63,815 | 77,361 | 112,671 |
| Bavaria | 85,457 | 153,581 | 128,147 | 142,497 | 216,382 |
| Belgium | 107,582 | 142,939 | 178,621 | 217,784 | 276,979 |
| Denmark | 46,443 | 51,871 | 110,856 | 104,400 | 119,253 |
| France | 254,532 | 360,299 | 413,616 | 463,973 | 817,473 |
| Germany | 166,935 | 248,905 | 277,870 | 289,831 | 513,129 |
| Greece | — | — | — | — | 5,493 |
| Holland..... | 143,780 | 194,565 | 228,964 | 266,992 | 391,613 |
| Norway..... | 32,918 | 68,020 | 83,011 | 97,174 | 124,353 |
| Portugal | — | — | 13,945 | 39,500 | 52,000 |
| Russia | — | 150,417 | 170,210 | 205,515 | 301,711 |
| Spain | 2,930 | 6,438 | 42,560 | 162,994 | 281,451 |
| States of the Church | 11,996 | 22,685 | 30,423 | 39,523 | 48,490 |
| Sweden | 60,611 | 116,673 | 174,864 | 180,364 | 181,119 |
| Switzerland | 166,541 | 232,067 | 265,365 | 252,800 | 293,746 |
| Wurtemberg | 41,451 | 63,978 | 56,131 | 71,628 | 96,207 |

| States. | 1860. | 1861. | 1862. | 1863. | 1864. |
|---------------------------|---------|-----------|-----------|-----------|-----------|
| Austria and Hungary | 727,274 | 919,789 | 1,021,612 | 1,105,501 | 1,692,610 |
| Baden | 128,670 | 148,350 | 182,246 | 226,655 | 307,399 |
| Bavaria | 205,450 | 230,192 | 265,768 | 319,408 | 396,581 |
| Belgium | 329,351 | 405,364 | 410,045 | 537,605 | 726,692 |
| Denmark | 152,381 | 197,417 | 203,150 | 238,634 | 170,210 |
| France | 977,281 | 1,268,459 | 1,976,144 | 1,895,930 | 2,694,361 |
| Germany | 623,325 | 741,085 | 967,321 | 1,222,692 | 1,767,679 |
| Great { Indo-European | — | — | — | — | 256 |
| Britain { Indian | — | — | — | — | — |
| Greece | 19,813 | 29,664 | 47,027 | 57,409 | 62,513 |
| Holland..... | 419,130 | 488,005 | 535,733 | 662,567 | 807,811 |
| Norway..... | 142,875 | 135,561 | 146,101 | 181,697 | 216,158 |
| Portugal | 62,000 | 73,500 | 85,500 | 93,000 | 104,000 |
| Roumania..... | — | — | — | 297,810 | 310,045 |
| Russia | 465,027 | 627,061 | 714,919 | 816,983 | 927,358 |
| Spain | 316,165 | 348,022 | 536,279 | 605,588 | 819,952 |
| States of the Church | 45,982 | 36,255 | 42,316 | 63,844 | 58,180 |
| Sweden | 173,231 | 185,398 | 483,419 | 689,142 | 759,934 |
| Switzerland | 312,256 | 340,907 | 392,142 | 468,394 | 527,939 |
| Wurtemberg | 106,122 | 148,826 | 175,426 | 197,454 | 268,130 |

TABLE XVI.—*Number of Telegrams from the Opening of the Lines—Contd*

| States. | 1865.* | 1866. | 1867. | 1868.* | 1869. |
|--------------------------|-----------|-----------|-----------|-----------|-----------|
| Austria and Hungary ... | 1,899,808 | 2,658,089 | 2,914,904 | 3,259,273 | 4,235,789 |
| Baden ... | 396,367 | 499,701 | 589,647 | 630,959 | 898,078 |
| Bavaria | 490,935 | 605,403 | 756,049 | 709,284 | 858,705 |
| Belgium | 938,467 | 1,439,842 | 1,650,159 | 1,823,080 | 2,038,308 |
| Denmark | 203,208 | 237,867 | 315,892 | 357,397 | 419,620 |
| France | 3,107,394 | 4,330,791 | 4,645,604 | 5,029,245 | 6,309,305 |
| Germany | 2,197,090 | 2,806,216 | 4,379,777 | 5,560,947 | 6,266,498 |
| Great { Indo-European | 23,433 | 29,246 | 29,064 | 33,005 | 46,389 |
| Britain { Indian | — | — | — | — | 522,676 |
| Greece | 85,457 | 102,870 | 106,435 | 101,837 | 112,808 |
| Holland | 972,394 | 1,094,803 | 1,120,225 | 1,506,802 | 1,643,390 |
| Italy | 2,058,364 | 2,345,028 | 2,137,674 | 2,315,624 | 2,407,863 |
| Norway | 242,175 | 290,098 | 333,835 | 378,915 | 429,105 |
| Portugal | 125,500 | 141,007 | 191,701 | 193,973 | — |
| Roumania | 352,829 | 438,158 | 475,686 | 557,181 | 598,116 |
| Russia | 1,044,375 | 1,416,351 | 1,589,417 | 2,028,949 | 2,399,410 |
| Spain | 1,006,252 | 901,514 | 793,829 | 784,887 | 1,072,451 |
| States of the Church ... | 97,792 | 106,901 | 116,317 | 101,520 | 111,185 |
| Sweden | 913,968 | 1,051,621 | 1,215,053 | 1,246,680 | 1,298,512 |
| Switzerland | 604,963 | 684,793 | 726,714 | 1,175,497 | 1,394,016 |
| Turkey | — | — | — | — | 671,320 |
| Wurtemberg | 337,779 | 432,249 | 435,149 | 498,513 | — |

Remarks.—**BAVARIA.**—Exclusive of service messages.

FRANCE.—In 1858, 1864, and 1865, the number of *received* international and “transit” messages is not included.

In 1863 *received* international messages are not included. Service messages are not counted.

GERMANY.—The number of *received* international messages is unknown prior to 1859.

ITALY.—The number of messages is unknown prior to 1865.

PORTUGAL.—No data for 1869.

ROUMANIA.—No data obtainable prior to 1863.

WURTEMBERG.—No data for 1869.

As regards the tariffs, no precise information can be obtained prior to 1865; they were, however, considerably reduced by the Paris and Vienna Conventions of 1865 and 1868.

* Tariffs reduced.

Table XVI gives the traffic for all the countries which have supplied this data to the telegraph convention, and by comparing the periods subsequent to the improved and diminished rates at the dates of the telegraph conferences held at Paris in 1865, and in Vienna in 1868, with those anterior, we find that unless disturbed by war or some exceptional conditions there is a very large and continuous increase in telegraphic correspondence.

Belgium has established the benefit to be derived from the augmentation of telegraphic correspondence in decreasing the cost of working each internal telegram. In Table VII we find the cost to the State per telegram, with the tariff at 1.50 fr., was in 1860, 2.11 frs.; but in 1869, with a 50 cent. tariff, the cost was only .86 c., but this reduced tariff had produced 387,000 telegrams each year in

excess of what would have been created under the *régime* of the high tariff.

It is this commercial activity which every State should encourage, as certain to add to the general prosperity and wealth-producing power of a nation, and bearing in mind the principle established, that the increase of internal telegrams with a low tariff is *enormous*, and the increase of deficit of net product only *slight*, with a tendency to diminish, I would submit to the telegraph department of India whether it might not be worth while to try a bold effort to introduce telegraphy into the habits of the Indian community.

I am of opinion this will never be done unless the tariff is reduced to some moderate standard represented by some small *current coin*, such as half a rupee.

The lines exist; the capital is expended; the stations are opened. The work can be greatly increased without material addition to the expenditure. There is no danger of competition upon any section which may prove exceptionally productive; *such as all private companies must always apprehend*.

It is more than probable that the indirect gain to the State will far more than compensate for the direct loss. Besides, as internal telegraphy grows, international telegraphy must also increase (although not in the same proportion), and it is certain that upon every international telegram there is a large profit to the State to compensate for the loss upon the internal telegrams; and this profit is all the greater, as the cost of working each telegram is diminished by an increase in the number of internal messages.

I know that the habits of the natives of India are unlike those of any European country, and I know, by experience, the indolent tendency of the climate; but Manchester has found the way to make cheap fabrics such as the natives will buy, and the exports and imports between this country and India have increased from nothing at all to 44,394,083*l.* in 1870. The railways have no doubt found a tariff which has induced the natives to travel; is there no proportion of this amount, which will induce them to telegraph? it is saving time in both instances; without wishing to be at all dogmatic or pretending to know as much as the gentlemen at the head of the telegraphs of India already know, I submit these foregoing principles and considerations, as impressing me with the idea that a low tariff for internal correspondence in India might in a few years produce a marked change for the benefit and prosperity of the country.

The Egyptian Traffic.

The line was first opened in 1861, at a tariff of 2*l.* for twenty words; and continued at the same rate until the summer of 1868, when it was reduced to 30*s.*

Up to this date, the frequent interruptions, by the breaking of the old cable, which unfortunately was laid in shallow water, set all statistics at defiance. There are evidences of extreme fluctuations on account of the demand for cotton during the American civil war; then a reaction owing to the panic of 1866; then a change during the Abyssinian War,—in the midst of which the cable broke.

Since the new cable was laid in 1868 there has been uninterrupted communication. The opening of the Suez Canal in 1869, gave an exceptionally good year; and then the war with France and Germany produced, in 1870, an exceptionally bad year, and all the data we have will prove nothing excepting an aggregate increase; which can be represented by a progressive 12 per cent. increase per annum since the opening of the line.

There are no social messages between Europe and Egypt worth estimating. The whole are commercial, financial, and political, and are not influenced by tariff to any material extent. A reduction of tariff to 17. would not produce such good results as an improvement in the speed and accuracy; and every effort is being made to make the service between this country and Egypt so rapid that a merchant can rely upon a reply to his message within the office hours of each day.

Should this increase the traffic as much as I anticipate, then I believe a reduction of tariff would soon follow.

Arguments which may be Expected to Induce Private Companies to Reduce their Tariffs.

I regret that I cannot think of any reason which should influence the directors of private companies to reduce their tariffs beyond the single *one of expediency*.

The foregoing pages prove conclusively, "*That every reduction of tariff leads to a diminution of the net product.*"

It may be expedient to reduce tariff with the object of staving off opposition and satisfying a popular demand, but this is sufficiently questionable, for the following reason:—

A reduction of tariff means a sacrifice of revenue for a length of time; and, after this sacrifice has been made, and is about to be rewarded by the gradual increase of revenue to the original point, there will be others ready to bring out rival cables upon the first publication of favourable receipts.

There is the danger already referred to, that after one company shall have made unproductive lines, they may be opposed upon the most productive sections by a new company with smaller capital.

I venture to say that these are points which never leave the minds of the directors of private telegraph companies.

Many Governments seem to delight in giving all sorts of concessions. We are never without a threat of opposition in one or more quarters, and there cannot be a more difficult question for the consideration of directors than that of determining *when it is expedient to make the sacrifice of lowering the tariff or extending their lines*.

There is only one way by which the full benefit of telegraphy can be obtained for the public at the expense of private enterprise. Governments could give monopolies with expressed conditions of a maximum tariff and reserve, and require that all revenue in excess of these amounts should be given to the public, either in the shape of increased facilities or reduced charges. The present insecure system is open every hour to competition, and can only result in amalgamation and higher tariffs to provide dividends for the greater amount of capital unnecessarily expended.

This amalgamation will probably only be effected after one or more companies have been almost ruined. I would, as a matter of private opinion, prefer the conditional monopoly referred to, in granting which the Government could stipulate that 2 per cent. upon the capital should be laid aside for renewals, repairs, and extensions, before any dividend was given to the shareholders; that this reserve should be continued and used for such extensions as the increase of trade demanded, and that no dividend should be divided in excess of 8 per cent., until every facility in the shape of reduced tariff and extensions had been supplied to the public that the Government might judge to be desirable. A reasonable limit in tariff would soon be established, below which no company would be expected to reduce; this point attained, and a large reserve provided, the company should then be allowed to divide the whole of their revenue.

This plan, or some modification of it, would ensure the maintenance of an efficient and reliable means of communication; it would ensure to the commercial public a supervision which would give them their reduced tariff whenever it became reasonable to do so; it would ensure to the shareholder a comparatively sound investment: in a very few years the reserve, and the duplication of the lines with the aid of this reserve, would make their dividend absolutely secure, but for this they would be required to sacrifice dividends, *if need be*, until their property had attained this sound position.

I commend a consideration of this subject to the shareholders, as the only basis upon which they could ask for, or the Government grant, a conditional monopoly.

At present we are not acting upon sound principles; most of the cable property is comparatively new, and large renewals may be required.

The property is exposed to opposition from the increasing energies of a host of concessionaires seeking concessions with the object of placing other and unnecessary schemes upon the public, or being bought off by existing companies. It is exposed to the inroads of packing companies, who boast their power of paying large dividends upon a small capital, and point with triumph to their public spirit in preventing the companies, which established the lines at a cost of millions, from earning dividends at the expense of the commercial public, forgetting, or not caring to remember, that if these companies do not pay a reasonably good dividend, and any accidents occur to the cables, capital could not be obtained to renew them ; if telegraphy had to be maintained in such a case, the whole burden would fall upon the Government,

The Government is therefore interested in maintaining these lines as a dividend-paying property, or they cannot be maintained in an efficient state. They can give the companies a security, and obtain for it a material advantage to the commercial public ; nor is it too much to ask that the 10,000,000*l.* of British capital invested should, by some such form, or by Act of Parliament, be defended from a competition which has not only no public good to serve, but must absolutely endanger the very existence of lines which have become a necessity to imperial and commercial interests.

If this, or some similar plan is not devised, then the alternative is, that Government should obtain the whole of the telegraphs, and, by making them only self-supporting, give the public the full advantage the system is capable of affording.

We have seen in the foregoing pages that the increase of *internal traffic* decreases the cost of working both internal and international telegrams. *Private companies obtain no benefit from this. Governments obtain all the benefit.*

It is established that lowering the tariff upon international messages diminishes the revenue directly derived from this class of correspondence, but it increases the traffic ; and it is certain that the increase of international traffic largely augments the increase of internal correspondence, both by telegraph and post office, and *Governments obtain all the benefit from this cause ; private companies cannot obtain any benefit whatever.*

All increase of telegraphy directly and certainly stimulates commercial activity, increases the wealth of a nation by multiplying transactions, enlarging incomes, thereby promoting a larger taxable surface for the benefit of the whole community and the amusement of the Chancellor of the Exchequer. Private companies can only obtain a minimum of advantage from the first effect, and none at all from the latter. *Government and the State are immediately benefited.*

Governments can, by *unity of management, by simplicity of through*

working, by *uniformity of system*, effect an enormous amount of saving that cannot be approached under the system of private management.

Governments can, by absence of competition, extend the system to such points as the Mauritius, Cape of Good Hope, New Zealand, the Andamans, Burmah, &c., &c., which, although comparatively unproductive, would yet, to a Government with a monopoly, become feeders to an extent which, in the aggregate, would be at least self-supporting. *No private company can afford this luxury.*

It follows, then, that Government have every advantage in their favour, every possible reason in the interest of good government and substantial benefit to the State to reduce all telegraphy to the point of being *simply a self-supporting system, not a dividend-paying system*, which it is the duty of private companies to maintain as long as possible.

There is one question in the minds of those who are not familiar with the subject which can easily be answered. *What would become of all this property in time of war?* My answer to that is, there is sufficient enlightenment amongst all nations to arrange conditions to control or suspend one or more cables or land telegraphs during the operations of war without resorting to the barbarism of destroying them; this was done during the civil war in America, and the telegraph remained intact to become the messenger of peace.

There is another important consideration in relation to this part of the subject. How will Government obtain possession of all these cables? but as that is not the subject of this paper, and not becoming in me to suggest or advocate, I shall leave it to others who may think it worthy of their attention.

I had no desire or intention of advocating the purchase of the lines by Government, nor yet did I intend to find reasons for the maintenance of a higher tariff upon international than upon internal telegrams, when I fixed my attention upon the effect of tariffs. The subject has been considered only with the view of arriving at as many fixed points as possible, and in the course of my investigations I found that Belgium had already mastered this subject; the greater part of my labour, since obtaining the Belgian report, has therefore been to examine and compare the statistics of all other countries, as well as those of private companies, with the principles advanced by Belgium; and, so far as my powers go, I cannot find any data to refute any of the deductions or principles given in the report.

APPENDIX.

I.—*An Account of Marine Cables Laid.*

The accompanying table contains as accurate a statement as I can obtain of all the submarine cables laid up to this date, and in the following remarks I state, what, in my opinion, this experience of twenty years has established.

This is by no means a new subject of investigation, but in the present day I am certain it will be instructive to many amongst the thousands who are now interested in this class of property, to have their attention briefly called to all that has been done to make submarine cables a sound property.

Eleven years ago there was a joint committee appointed by the "Lords of the Committee of Privy Council for Trade and Atlantic Telegraphy, to inquire into the construction of submarine cables, together with other evidence."

The report is dated April, 1861, and is signed by Douglas Galton, C. Wheatstone, W. Fairbairn, Edwin Clark, Cromwell F. Varley, Latimer Clark, and George Saward, and they state that they had the benefit of the advice of the late Mr. Robert Stephenson.

They examined forty witnesses, all eminent in their day, and numbering amongst them most of the names which are yet conspicuous in the engineering, manufacture, and submerging of this class of property.

Fifty cables had been laid at the date of this investigation, all upon the same general principle.

Eight thousand miles had been lost, all belonging to four undertakings, viz., The Atlantic, Red Sea and India, Sardinia-Malta, Corfu-Malta, and Singapore to Batavia cables.

They state that the loss of all these cables was "attributable to defined causes, which might have been guarded against," and they "believed there were no difficulties to be encountered which skill and prudence would not overcome."

The committee considered it unreasonable to expect more rapid progress than had then been made, the first few cables laid in shallow water across the channel were comparatively easy to recover and repair; they had been manufactured without much necessity for extreme care, and had been accepted as successful precedents; further investigation was considered unnecessary, and bold attempts were made to lay cables of a similar type under entirely different conditions, but "they considered it doubtful whether the transmission of messages for even so short a period as three weeks through a cable across the whole width of the Atlantic, was not a result worth all the expenditure which had been incurred."

Attention is called in the report to the "*remarkable fact that in almost all cases small cables had been found liable to mishaps, while the heavier the cable had been the greater had been its durability.*"

At the date of this report, the twenty-nine types of cable illustrated on the sheet which I exhibit, had been experimented upon, upwards of 1,300 tests had been made by Messrs. Siemens, Forde,

and Gisborne, for Her Majesty's Government, with the object of discovering the best form of cable, and many hundreds of tests besides had been made by Messrs. Glass Elliot, Messrs. Newall, Messrs. Siemens, Messrs. Silver, and many others with the same object; at this date 1859 to 1861 there were ample data for investigation, and there were many eminent and practical men of experience in this class of enterprise, we are not therefore disappointed in the result of the inquiry. The report is full and complete, and *establishes principles which up to the present time have uniformly guaranteed success, while the neglect of them has as uniformly resulted in partial loss or failure.*

LOSS OF CABLES.

The loss of cables was found to be attributable to the following causes:—

A. First, and the most important of all, from *imperfect manufacture*, resulting without doubt prior to this date from inexperience of the materials for insulating the copper wire, and from ignorance of the fact discovered by Professor Thompson about 1856, viz., that some kinds of copper wire were no better than iron for the purpose of conductivity, and that it required carefully selected copper to give the desired standard, which may be represented by a copper wire one-tenth of an inch in diameter, being equal to an iron wire one-third of an inch in diameter for electrical purposes.

All cables manufactured previous to this date had no advantage from this discovery.

There appear to have been mechanical difficulties in keeping the copper conductor in the centre of the insulating medium, so that the copper was sometimes found to be almost visible under the light film of gutta percha which covered it. The electric current soon weakened this film, stronger currents were used to overcome the weakness of the signals, and the cable was soon destroyed. Experience about this time had established that

A cable from the commencement of its manufacture to the time of its being laid should be tested under water and under pressure, and kept as much as possible under all the conditions in which it was meant to continue.

Sir S. Canning taught that the "*great secret was to keep a cable quiet from the time it was made until it was laid,*" and no one disputed the fact that *every time a cable is coiled or uncoiled it sustains more or less injury.*

B. Attempts to lay cables from sailing ships towed by steamers was another source of failure. The ships had not enough steerage way when met by strong head winds, and too much slack was paid out. It was difficult under such circumstances to steer a straight course, and sailing ships possessed no power of being readily stopped when a fault or accident occurred.

C. Many accidents happened from inexperience in the method of paying out cables; at the present day the wonder is that they should have succeeded so well with the rude methods and inexperience which then existed, and not that there should have been many failures and much recrimination. Reading the history of

these first attempts to place a network of cables at the bottom of the ocean fifteen and twenty years ago, is a good deal like reading the old stories of the early voyages of discovery. There are difficulties and disasters peculiar to every attempt, and the grand result is that one way or another they were overcome, or else they suggested such modifications that their recurrence was avoided, and an accident to a well-manufactured cable no longer constitutes a loss.

We read of the vessel paying out the Toulon-Algiers cable being run into by the French ship sent to assist her, and the cable, although buoyed, was lost.

Another attempt failed "from a fracture due to the occurrence of a storm."

They were five days in laying the Corsican cable, a distance of only 70 miles. "They used to anchor at night holding on to the cable waiting for daybreak."

The first attempt to lay the Sardinia-Bona cable failed from the cable breaking while trying to recover it by "*heaving it in with the windlass.*"

In the second attempt they ran short of cable; the vessel sent to guide led them out of their course. When day broke the ship which was leading was dressed with flags ready to land the cable with startling *éclat*, but they were steaming in the wrong direction, and there was not cable enough on board to allow for the error which had been committed. "The ship held on to it for four or five days, sent another steamer to bring assistance; rough weather came on, and the cable broke in 400 fathoms."

The third attempt failed "owing to imperfect manufacture."

The first Atlantic cable failed principally on account of imperfect manufacture, in a great measure arising from undue haste and urgency, but largely owing to insufficient experience.

The cable was not tested under water for fear of rusting the small steel wires of the external covering, and small wires have never since been used; large wires, the larger the better, is now a principle.

The copper was not all good.

It had often been coiled and uncoiled, and had been exposed to the strong heat of the sun, and to many changes of temperature.

Any of these conditions would now-a-days be regarded as enough to condemn the most carefully manufactured cable.

The Red Sea and Indian cables are said to have been imperfectly manufactured and laid too taut, but *they were not tested under water from the time of manufacture until they were placed at the bottom of the sea*, and this one grand omission, largely due to inexperience, is enough without the recriminatory points to condemn to loss and failure any cable whatever.

The cables laid from Cagliari to Malta and Malta to Corfu are said to have failed from imperfect manufacture. One experienced gentleman in his evidence said these cables were "such as nobody should have laid in deep water." It is sufficient at present to know that they have failed from neglect or inexperience, and that they, amongst other failures, have established the principles which have since ensured success.

D. The want of constant supervision by engineers, exclusively in the interests of the purchasers of the cable, has been a great cause of defective cables.

There may often be minute defects in the core itself, or a slightly defective splice which may reduce the electrical condition of a comparatively short length; this may easily be raised above the average standard required by the contract, by the next length being more carefully manufactured.

These minute defects must, however, kill the cable in more or less time, and the principle is established that—

Every inch should be tested in course of manufacture, and rejected if there is any irregularity of condition to cause suspicion.

There should be constant supervision, and a record of all the tests kept for the purchasers of the cable from the commencement of the contract to its final completion, and continued ever afterwards by the purchasers.

CAUSES OF INJURY TO CABLES.

The principal sources of injury to cables are: 1st, moving water either currents or tides, chafing the cables upon rocks or shingle. Experience has given many costly lessons of the effect of moving water.

Ten years ago it was generally believed that water had very little motion below 50 fathoms, and 100 fathoms was considered a point of great safety. We now know that there are exceptional localities where there is motion in the water at a depth of 500 fathoms. The Falmouth cable was chafed and destroyed at this depth from this cause.

The Channel Islands cable was also destroyed from the same cause.

The first cable ever manufactured with due regard to the principle of careful supervision, testing under water, and being retained quietly in that condition until it was laid, was the Malta and Alexandria cable laid in 1861.

This cable was submerged in too shallow water, for many miles in less depth than 20 fathoms; the result was the frequent recurrence of fracture from being rolled about by the surf, and yet this cable was only finally abandoned last year; not because it could not be kept in repair, but because it was too expensive to keep in order.

These and many other examples have established the principle that

No cable should be laid without first obtaining an accurate survey of the approach to the coast and landing places, with accurate soundings over the intended route, and as much knowledge as possible of the nature of the bottom.

Currents and anchorage should be avoided, and where that is impossible, the heaviest cable that can be laid should be provided.

Heavy cables should be laid out to depths of 400 fathoms, where there are tide-ways.

Where a current exists, a position should be sought for as far removed from it as possible.

A great cause of injury to cables is the corrosion of the external

wires, caused by moving water or marine vegetation, &c., and this has established the general practice of covering the external wires with tarred yarn saturated with a mixture of pitch and silica. There is still great room for improvement upon the present method of protecting the external covering of cables, and I commend it to the further careful study of telegraph engineers as a subject of vital importance.

Another enemy of submarine cables is the toredo of all kinds; there is one kind which has proved destructive by boring through the core, but that has only occurred in shallow water; there is another kind which destroys the hemp in a few months, and is then satisfied to fix itself upon the gutta percha and remain there. *Cables have been recovered from depths of 1,200 fathoms with all the hemp eaten away, and the core pitted with these marine animals. The recovery is then only possible by the strength of the external wires.*

All the experience we have points to the value of protection, first, of the core, then of the external covering, and if those responsible for the safety and maintenance of submarine cables could be allowed to dictate the most desirable conditions of safety they would select, besides the strongest possible cable to be manufactured, and laid with extreme care, a depth of water of about 500 fathoms, and a bottom of sand or mud; but as this cannot always be secured, nothing should be omitted in the direction of strength and quality.

Lightning is still another source of injury to cables, this is, however, so readily guarded against that we no longer hear of injury from this cause; it is said to have destroyed three cables. Mr. Siemens produced before the committee a piece of the core of the Corfu cable injured by lightning; the land line had been struck, and from the absence of any lightning guards, the cable was damaged.

Mr. Preece described the Jersey cable to have been destroyed by lightning.

Mr. Fleeming Jenkin had seen a fault 18 inches long due to this cause, and it is asserted that the same cause destroyed the Toulon-Algiers cable, which was connected to the land lines without lightning guards.

INJURY FROM ACCIDENTS AND OTHER CAUSES DURING THE PROCESS OF SUBMERGING.

The most frequent injury arises from the wire with which the cable is covered, being too brittle or parting at the scarf joints, and at once becoming little poignards, liable to pierce the core during the process of laying. The necessity for laying the cable at a moderate speed and with great care, prolongs the voyage across a broad ocean for many days and nights, and it is not surprising that these broken wires should at times pierce the core and necessitate the instant hauling back of the cable, no matter what the depth of water, or what the condition of weather may be, and this establishes the principle:—

That all cables should be made with due regard to the depth of water in which they are to be laid, and strong enough to admit

of being recovered in case of accident, which may as probably occur during a tempest as during a calm.

But accidents from this cause seldom or never occur (I do not know of a single instance) when the external wires are covered with yarn and bituminous compound; this covering has therefore the double value of protecting the external wires, and adding greatly to the safety while laying.

There are, besides, accidents liable to occur at sea which no human foresight can guard against; over a period of ten or twelve days, more or less bad weather is almost certain to occur, and should at all events be provided for by a margin of strength.

What are called foul-flakes and kinks, and accidents to machinery and to the men have occurred, and may occur again, requiring the ship to be suddenly stopped, and great strain to be thrown upon the cable, and it is sometimes necessary to cut and buoy, and leave it for several days.

That accidents need not occur often, and might not occur at all at times, is not sufficient argument to justify a cable being made unequal to an emergency.

LIGHT CABLES.

We are every now and then startled by the announcement that light cables are to be preferred to the present iron-clad type, and the object of this investigation has been to discover what data there are to justify any preference to one form of cable over another.

I have said already that the committee called attention to the remarkable fact that, in almost all cases, small cables had been found liable to mishaps, *while the heavier the cable the greater had been its durability.*

Mr. Newall, in his evidence, said that the hemp-covered cable which he attempted to lay in 1859, between Candia and Egypt, had the hemp eaten off by the toredo in a very short time, *and it was too weak to recover for repairing.*

The same firm laid an unprotected core from Varna to the Crimea, and it lasted until the winter set in; it is frequently said that it was cut by order of the French Commander-in-Chief, but there is no proof of this, and I am not disposed to believe it. Mr. Woodehouse, the engineer who laid this core, said in his evidence "*he should not advise anybody to lay so light a cable across the Atlantic, because so small a strain would break it. If it is once safe at the bottom perhaps it may rest.*"

Mr. Newall said he thought it folly to lay anything excepting unprotected core. Consistently with this conviction, he laid in 1869 several lines of unprotected indiarubber core, connecting the Grecian Islands with the main land; they were protected only near the shore.

The sea is quiet and tideless in those parts; no better spot could be wished for the experiment, *yet they every one of them gave out within two years.*

The Red Sea cable, covered externally with light wires, and unprotected with bituminous compound, was so rusted in a short time that it could not be lifted for repairs.

Notwithstanding Mr. Newall's partiality for light cables, he suggests at the close of his evidence what I assume he would consider the most perfect form of cable. He would cover the copper with indiarubber, protect this core with steel wires vulcanised, the whole then passed through heat; thus insulating all the wires he would make the cable in one length, and have no joints.

Mr. Lionel Gisborne considered a hemp-covered cable "perfectly useless for laying in water; it has both the liability to stretch and to shrink."

Mr. Fleeming Jenkin in his report to the International Exhibition of 1862, says:—

"So long as the iron wires lasted, the cables frequently continued to work in spite of faults, but sooner or later the iron wires of all these light cables rusted away in parts; so soon as this took place they one and all broke up into short sections; this fact has been observed in depths of 100 fathoms;" the reasons were not obvious to Mr. Jenkin, but he says: "*meanwhile the use of large iron wire seems a sure guarantee against this danger, for as yet no cable covered with wire of the large gauges has ever parted in the manner described.*"

"*The difficulty is to find a permanent material which shall retain its strength and continue to afford protection after the cable is laid.*"

Every word of this can be written at the present moment, that is, ten years later, with exactly the same significance.

All cables which have been manufactured and laid upon the principles which were established in 1859, are yet in good working order, and every divergence from these principles has been at best a costly experiment or utter failure.

It is urged as a strong reason in favour of unprotected core (light cable) that there are many miles of cables now in existence from which the outer covering has fallen off by decay or otherwise; but I am not of that opinion, and it can only be an opinion. In many cases, perhaps in all, the outer covering may have lost much of its strength, but it is more likely to have the merit of keeping the core protected and undisturbed, owing to its weight and accumulation of deposit upon it than to have fallen off and left the core unprotected.

I am of opinion that whenever the outer covering falls off, the life of the cable will be very short; and I am prepared to expect that in many of the cables now laid all the shallow water parts will have to be renewed from time to time.

There is no instance yet of a well-manufactured heavy cable breaking or giving out in deep water after it has been carefully laid free from defects, but there may be much due to the external covering keeping it quiet, there has assuredly been a great deal due to the external covering in the successful submerging, *and there is no experience whatever to justify the assumption that an unprotected core would last, even if laid.*

It has been urged that an iron-covered cable suspended from one point to another gradually becomes weaker, that rust and marine growth or deposit accumulates and breaks the cable with their weight; but I do not know of any instance in support of this

assumption, nor is it at all certain that a simple unprotected core would exist for any length of time, or be in any way better adapted for the supposed conditions.

Mr. Latimer Clark in his evidence says :—" You want a certain degree of weight to enable your cable to sink steadily to the bottom, especially when it has to fall into hollows and cavities, and not lay loosely across elevations."

Again, it is urged that experiments with light cables have been tried in factories or sheds, and the result proves that there are many advantages in their favour; but I am of opinion that no experiments which can be made on shore will sufficiently resemble the exigencies which may occur over a period of several days and nights at sea in storms and darkness, and still less will they prove their fitness for the unknown conditions which may exist at great ocean depths.

I desire to write with great respect for the opinions of the talented men who urge the adoption of light cables; it is my special duty to weigh well and without prejudice all they have to advance, but I think a careful investigation into the experience and practice of the last twenty years establishes conclusively *that all light cables have been short-lived, and that all heavy cables have continued working, often under most adverse conditions.*

It is my own opinion, and I am authorised to say, that it is also the opinion of my friend Captain Halpin, who has laid all the cables from Suez to Australia, besides the French Atlantic cable (11,000 miles), and has also recovered and repaired cables from a great variety of depths—that a cable should be as heavy as it can be laid with safety and admit of being recovered in case of accident. *Multiply every precaution which shall increase the strength and keep that strength intact as long as possible.*

The best form of light cable I have seen is the copper-covered core invented by Mr. Siemens (No. 8). I should have anticipated that if any light cable could have been successful, this one would have met all the conditions, excepting that of extreme cheapness, but it has not been so uniformly successful as the heavy iron-clad cables.

The very light cable invented by Mr. Varley (No. 21) admits of being laid by having the strain taken off the core by the two hempen strands, the core itself being the third strand of the cable. As a light cable to be manufactured in a great hurry and laid to meet some emergency, it has a good deal of merit, but for a deep sea cable, I am of opinion that it would be found too incomplete and unfinished, and that difficulties would be experienced in laying, which are not at once foreseen, and that there would be no durability even if successfully laid.

Every day of my experience in watching over the permanence of the 10,000 miles of cable under my care, confirms me in the opinion that too great caution and vigilance cannot be exercised in making and laying a thread which is to be removed from all human vision for ever, and designed to earn dividends by continuing a perfect conductor of electricity.

Upwards of 30,000 miles of cable have been laid since the report

of the committee was printed eleven years ago, and much experience has been gained of the exigencies incidental to submerging, buoying, grappling, and repairing; but no fact has resulted from all that experience which has established that any one precaution recommended in the report has been superfluous, whereas much has occurred, which I will not particularise, proving that any attempt to disregard any single precaution has resulted in great pecuniary loss or utter failure.

We have many reasons to confirm the belief that a submarine cable, manufactured and laid with strict attention to all known principles, may be regarded as a substantial property, likely to last for any length of time; for there is no evidence whatever upon record which shows any decay of the insulating medium or copper conductor of a well-manufactured cable, *i.e., there is no decay inherent in the nature of a cable, all deterioration is external; nor is there any experience whatever to establish that this insulated copper wire will enjoy any durability if unprotected with an external covering.*

A light cable or unprotected core must therefore be regarded at best as an experiment, with the chances against the successful laying, and still more against its existing as a permanent property.

I have written enough to illustrate that the present submarine cable (No. 9) is not a hap-hazard idea, but one which has grown out of many failures and thousands of experiments; all the principles of manufacture and laying down have been established by great anxiety and reflection on the part of the able men who gave their energies to this kind of enterprise prior to 1865. We who have come upon the stage since that date, have only discovered that we may not neglect one of all the known principles, but if possible elaborate every one of them, and even then the duty and responsibility of laying and maintaining this class of property, has enough of risks and anxieties to make one heartily dislike any experiment which can only be advocated for the sake of cheapness in the first cost. *I believe this economy would be at the expense of security, and that the cable of the future will be even heavier, more perfect, and more costly than the cable of the present day.*

II.—*List of the Cables, their Length and Weight, and Sea Depth.*

| Date. | From | To | Length in Miles. | Weight per Mile in Tons. | Greatest Depth in Fathoms. |
|----------|-----------------------------|--------------------|------------------------|--------------------------------|----------------------------------|
| 1850... | *Dover | Calais | 25 | 0'2 | 30 |
| 1851.... | Dover | Calais | 25 | 6'0 | 30 |
| 1852 { | Keyhaven | Hurst Castle | 3 | — | 20 |
| | *Holyhead | Howth | 65 | 1'57 | 83 |
| | *Port Patrick | Donaghadee | 15 | — | 160 |
| | *" | " | — | — | 149 |
| | *Prince Edward Island | " | 12 | — | 18 |
| 1853 { | Denmark, across Belt | — | 18 | 4'0 | 15 |
| | River Tay | — | 2 | — | — |
| | Dover | Ostend | 76 | 5'75 | 30 |
| | Firth of Forth | — | 5 | 1'75 | 7 |
| | Port Patrick | Donaghadee | 25 | 6'0 | 160 |
| | *England | Holland | 115 | 1'75 | 23 |
| 1854 { | Port Patrick | Whitehead | 27 | 6'0 | 150 |
| | Sweden | Denmark | 12 | 6'0 | 14 |
| | *Corsica | Sardinia | 10 | 8'0 | 20 |
| | *England | Holland | 120 | 1'75 | 30 |
| | *Holyhead | Howth | 65 | 2'0 | 80 |
| | *Spezzia | Corsica | 110 | 8'0 | 325 |
| | Holyhead | Howth | 65 | 2'0 | 83 |
| 1855 { | *Sardinia | Africa | 50 | 8'0 | 800 |
| | *Cape Ray | Cape North | 74 | 2'2 | 360 |
| | *Sardinia | Africa | 160 | 3'7 | 1,500 |
| | *Varna | Balaclava | 310 | 2½ cwt. | 300 |
| | *Eupatoria | " | 60 | 0'75 | 69 |
| | *Varna | Kilia | 179 | — | 30 |
| | Egypt | — | 10 | 5'25 | — |
| | *Italy | Sicily | 5 | 5'25 | 27 |
| | *England | Holland | 123 | — | 23 |
| | *" | " | 119 | — | 23 |
| 1856 { | *Cape Ray | Cape North | 85 | 2'5 | 300 |
| | Prince Edward Island | — | 12 | 2'5 | 14 |
| | Across Gulf of Canso | — | 1½ | 2'2 | — |
| | *Crete | Alexandria | 350 | — | 1,350 |
| | *" | Syra | 170 | — | 1,020 |
| | St. Petersburg | Cronstadt | 10 | — | 10 |
| | Bosphorus | — | 1 | — | 40 |
| 1857 { | Across Amazon | — | 105 | — | — |
| | *Sardinia | Bona | 150 | 1'85 | 1,500 |
| | *" | Malta | 500 | 0'9 | 1,000 |
| | *Corfu | " | 500 | 0'9 | 1,000 |
| | *Portland | Alderney | 69 | 2'5 | 60 |
| | *Alderney | Guernsey | 17 | 2'5 | 44 |

* Not working February, 1872.

II.—*List of the Cables, their Length and Weight, and Sea Depth—Contd.*

| Date. | From | To | Length in Miles. | Weight per Mile in Tons. | Greatest Depth in Fathoms. |
|---------------------|-----------------------|----------------------|------------------------|--------------------------------|----------------------------------|
| 1857 | *Guernsey | Jersey..... | 15 | 2'5 | 60 |
| | Norway Fiords | — | 49 | 2'75 | 300 |
| | Ceylon..... | Mainland | 30 | 2'75 | 45 |
| | Danube | — | 3 | 1'75 | — |
| | Ceylon..... | Mainland | 30 | 2'75 | 40 |
| 1858 | *Italy | Sicily | 8 | 5'25 | 40 |
| | England | Holland | 129 | 9'75 | 27 |
| | *Cromer | Emden | 280 | 3'0 | 28 |
| | Norway Fiords | — | 16 | 2'75 | 300 |
| | *Atlantic | — | 2,036 | 1'0 | 2,400 |
| | *Dardanelles..... | Khios | 565 | 0'94 | 1,100 |
| | *Khios | Syra | | | |
| | *Syra | Athens | | | |
| | *Khios | Smyrna | | | |
| 1859 | *Crete | Alexandria..... | 150 | — | 1,600 |
| | * | ” | — | 0'9 | 1,350 |
| | *Singapore | Batavia | 630 | 0'94 | 20 |
| | Denmark..... | Heligoland | 46 | 4'0 | 28 |
| | *Cromer | ” | 328 | 4'0 | 30 |
| | Isle of Man | Whitehaven | 36 | 2'5 | 30 |
| | Sweden | Gottland | 64 | 2'5 | 70 |
| | Folkestone | Boulogne | 24 | 9'5 | 30 |
| | India Rivers | — | 10 | 4'5 | — |
| | Malta | Sicily | 60 | 3'25 | 75 |
| | Jersey | Pirou | 21 | 3'75 | 10 |
| | *Otranto | Avlona | 50 | 0'9 | 400 |
| | *Ceuta | Algeciras | 25 | 1'0 | 700 |
| | Alexandria | — | 2 | — | — |
| | Lynas | Great Ormes Head | 19 | 3'1 | 14 |
| | Ayr | Mimbres Island | | | |
| | *Cape Otway | King's | 240 | 2'0 | 60 |
| | *King's Island | Hummuck | | | |
| | *Hummuck Island | Circular Head | | | |
| 1860 | Great Belt | — | 14 | 8'0 | 18 |
| | ” | — | 14 | 5'5 | 18 |
| | *Dacca | Pegu | 116 | 0'9 | 50 |
| | *Port Vendres | Algiers | 520 | 1'14 | 1,585 |
| 1859 and 1860 | *Suez | Cassire | 255 | 0'94 | { Shoal water |
| 1860 | *Suakin..... | Cassire | 474 | | |
| | * | Aden | 627 | | |
| | *Aden | Hellania | 718 | | |
| | *Hellania | Muscat | 486 | | |
| | *Muscat | Kurrachee | 481 | | |
| 1860 | *Barcelona | Mahon | 198 | 1'25 | 1,400 |
| | *Minorca | Majorca | 35 | 1'9 | 250 |

* Not working February, 1872.

II.—*List of the Cables, their Length and Weight, and Sea Depth—Contd.*

| Date. | From | To | Length in Miles. | Weight per Mile in Tons. | Greatest Depth in Fathoms. |
|----------|--------------------------------|--|------------------------|--------------------------------|----------------------------------|
| 1860 { | Iviza | Majorca | 74 | 1'9 | 500 |
| | *St. Antonio | Iviza | 76 | 1'9 | 450 |
| 1861 { | Corfu | Otranto | — | 3'4 | 1,000 |
| | *Malta | Tripoli | 230 | 2'5 | 385 |
| | *Tripoli | Bengazi | 508 | 1'85 | 420 |
| | *Bengazi | Alexandria | 593 | { 4'5 6'0 } | 80 |
| | Norway Fiords | — | — | 2'75 | 300 |
| | Dieppe | Newhaven | 80 | 8'0 | 25 |
| | *Toulon | Corsica | 195 | 1'14 | 1,550 |
| 1862 { | Wexford | Abermam | 63 | 5'25 | 50 |
| | Lowestoft | Zandvoort | 125 | 9'0 | 27 |
| | Across Cork Har- bour | — | — | 0'6 | — |
| | Across Blackwater | — | — | 1'75 | — |
| | Greencastle | Cape Clear | — | — | — |
| | Bristol Channel | — | — | 3'5 | 26 |
| 1863.... | *Cagliari | Sicily | 211 | 1'8 | 1,025 |
| 1864 { | *Cartagena | Oran | 130 | — | 1,420 |
| | Gwador | Elphinstone Inlet | 357 | — | 437 |
| | Mussendom | Bushire | 393 | { 4'3 } | 97 |
| | Bushire | Fao | 154 | | 19 |
| | Gwador | Kurrachee | 246 | | 670 |
| | Otranto | Avlona | 50 | | 347 |
| 1865 { | Indian Rivers | — | — | — | — |
| | Sylt | Tondern | 6 | — | — |
| | *Bona | Sicily | 270 | — | 250 |
| | Trelleborg | Rugen | 55 | 8'0 | 80 |
| | South Foreland | Cape Grisney | 25 | — | 30 |
| 1866 { | Atlantic | — | 1,896 | 1'75 | 2,424 |
| | ” | — | 1,852 | 1'5 | 2,424 |
| | Lyall's Bay | White's Bay | 41 K | 9'1 | 50 |
| | Crimea | Circassia | 40 | — | — |
| | Colonia | Buenos Ayres | 30 | 12'0 | 4 |
| | England | Hanover | 224 | 10'9 | 27 |
| | Cape Ray | Aspee Bay | 91 | — | 200 |
| | Leghorn | Corsica | 65 | — | 100 |
| | Persian Gulf | { Additional cable to connect Jask | 160 | — | 110 |
| | *Khios | Crete | 200 | — | 1,200 |
| | South Foreland | La Panne | 47 K | 9'7 | 28 |
| 1867 { | Ceylon | — | — | — | 10 |
| | Malta | Alexandria | 925 K | 1'5 | 2,000 |
| | Havana, Cuba | Key West | 125 | 2'5 | 20 |

* Not working February, 1872.

II.—*List of the Cables, their Length and Weight, and Sea Depth—Contd.*

| Date. | From | To | Length in Miles. | Weight per Mile in Tons. | Greatest Depth in Fathoms. |
|-------|-----------------------|--------------------|------------------------|--------------------------------|----------------------------------|
| 1867 | Key, West | Punta Russa | 120 | 2'5 | 20 |
| | Placentia | St. Pierre | 112 | 2'5 | 76 |
| | St. Pierre..... | Sydney | 188 | 2'5 | 250 |
| | Arendal | Hirtshalts | 66 | — | 110 |
| 1868 | Messina Straits | — | 5 | 6'0 | 40 |
| | Havanna..... | Key West | 125 | — | — |
| 1869 | Peterhead | Egursand | 250 | 3'0 | 70 |
| | Grisselhamn | Nystadt | 96 | 3'0 | 47 |
| | Newbiggin | Sondervig | 334 | — | 48 |
| | *Black Sea | — | 300 | — | — |
| | *Scilly Isles | Land's End | 27 | 6'0 | 40 |
| | Malta | Sicily | 54 | 1'5 | 75 |
| | Tasmania | Australia | 176 | 2'0 | — |
| | Scilly Isles | Land's End | 27 | 3'0 | 42 |
| | *Corfu | Sta. Maura..... | 50 | — | 160 |
| | *Sta. Maura..... | Ithaca | 7 | — | 180 |
| | Ithaca | Cephalonia | 7 | — | — |
| | *Cephalonia | Zante | 10 | — | 60 |
| | Bushire | Jask | 505 | 4'3 | 97 |
| | Brest | St. Pierre | 2,584 | 1'6 | 2,760 |
| | St. Pierre..... | Duxbury | 749 | 2'8 | 259 |
| | Moen | Bornholm | 80 | 4'0 | 28 |
| | Bornholm | Libau | 230 | 3'5 | 62 |
| | Scotland | Orkney Isles | — | — | 37 |
| | Salcombe | Brignogan | 101 | 2'78 | 59 |
| | Beachy Head | Cape Antifer | 70 | 11'75 | 34 |
| 1870 | Suez | Aden | 1,460 | 2'75 | 968 |
| | Aden | Bombay | 1,818 | 1'75 | 2,060 |
| | Porthcurno..... | Lisbon | 823 | 1'6 | 2,625 |
| | Lisbon | Gibraltar | 331 | 1'5 | 535 |
| | Gibraltar..... | Malta | 1,120 | 1'5 | 1,450 |
| | *Porthcurno..... | Mid Channel..... | 65 | — | 62 |
| | Marseilles | Bona | 447 | 1'75 | 1,600 |
| | Bona | Malta | 386 | 1'75 | 650 |
| | Madras | Penang | 1,408 | 1'4 | 1,284 |
| | Penang | Singapore | 400 | 3'4 | 36 |
| | Singapore | Batavia | 557 | 3'5 | 22 |
| | Malta | Alexandria..... | 904 | 1'5 | 1,440 |
| | Batabano | Santiago..... | — | — | — |
| | Jersey | Guernsey | 16 | 7'0 | 32 |
| | Guernsey | Alderney | 18 | 7'0 | 30 |
| | Sta. Maura..... | Ithaca | 7 | 3'5 | 180 |
| | Zante | Trepito | 11 | 3'5 | 235 |
| | Sunium | Thermia | 25 | 3'5 | 160 |
| | Patras | Lepanto | 2 | 3'5 | 20 |
| | Dartmouth | Guernsey | — | — | 58 |
| | Guernsey | Jersey | — | — | 32 |
| | Porto Rico | St. Thomas | 110 | — | 22 |
| | Santiago | Jamaica | 140 | — | — |
| | Portpatrick..... | Donaghadee | 25 | — | 160 |

* Not working February, 1872.

II.—*List of the Cables, their Length and Weight, and Sea Depth—Contd.*

| Date. | From | To | Length in Miles. | Weight per Mile in Tons. | Greatest Depth in Fathoms. |
|------------------------------|--------------------|--------------------|------------------------|--------------------------------|----------------------------------|
| 1871 | Javea | Iviza | — | } 2'75 { | 430 |
| | Majorca | Minorca | — | | 93 |
| | Villa Real | Gibraltar | 155 | | 84 |
| | Marseilles | Algiers | — | 3'5 | 1,625 |
| | Singapore | Saigon | 620 | 2'5 | 60 |
| | Saigon | Hong Kong | 975 | 3'5 | 630 |
| | Hong Kong | Shanghai | 1,100 | — | 42 |
| | Shanghai | Nagasaki | } 1,200 | — { | 135 |
| | Nagasaki | Vladivostock | | | 80 |
| | Rhodes | Marmarice | | | — |
| | Latakiah | Cyprus | 22 | — | — |
| | Samos | Scala Nuova | 86 | — | — |
| | Mytelini | Aivali | 11 | 1'5 main | 82 |
| | Khania | Retimo | 13 | 2'5 inter | 33 |
| | Retimo | Khandia | 32 | 6'0 S.E. | about 200 |
| | Khandia | Rhodes | 41 | — | 152 |
| | Khios | Chesme | 201 | — | 600 |
| | Zante | Corfu | 6 | — | 33 |
| | " | Cephalonia | 150 | — | — |
| | Lowestoft | Greitsee | 18 | — | 203 |
| | Anjer | Telok Betong | 223 | 7'5 | 23 |
| | Banjoewangie | Port Darwin | 55 | 3'5 | 50 |
| | St. Thomas | St. Kitts | 1,082 | 3'5 | 1,580 |
| | St. Kitts | Antigua | 133 | — | 1,170 |
| | Antigua | Guadaloupe | 90 | — | 130 |
| | Guadaloupe | Dominica | 84 | — | — |
| | Dominica | Martinique | 55 | — | — |
| | Martinique | St. Lucia | 60 | — | — |
| | St. Lucia | St. Vincent | 65 | — | — |
| | St. Vincent | Barbadoes | 64 | — | — |
| | " | Grenada | 150 | — | — |
| | Grenada | Trinidad | 80 | — | 156 |
| | Trinidad | Demerara | 120 | — | — |
| | Porto Rico | Jamaica | 350 | — | — |
| | | | — | — | — |
| Total number of cables | | | 213 | | |
| Total length in miles | | | 45,783½ | | |