

DEPARTMENTAL COMMITTEE ON TELEGRAPHISTS' CRAMP.

R E P O R T

OF THE

DEPARTMENTAL COMMITTEE

ON

TELEGRAPHISTS' CRAMP.

resented to both Houses of Parliament by Command of His Majesty.



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DEPARTMENTAL COMMITTEE ON TELEGRAPHISTS' CRAMP.

Terms of Reference.

To enquire into the prevalence and causes of the disease known as telegraphists' cramp, and to report what means may be adopted for its prevention.

Committee.

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Mr. A. G. LEONARD.
Mr. T. F. PURVES, A.M.I.E.E.
Mr. JOHN SINCLAIR, M.D. Dunelm, M.R.C.P. Lond.
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Mr. S. A. PATERSON (*Secretary*).

DEPARTMENTAL COMMITTEE ON TELEGRAPHISTS' CRAMP.

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DEPARTMENTAL COMMITTEE ON TELEGRAPHISTS' CRAMP.

REPORT

OF THE

Departmental Committee appointed to enquire into the Prevalence and Causes of the Disease known as Telegraphists' Cramp, and to report what Means may be adopted for its Prevention.

To the Right Honourable HERBERT SAMUEL, M.P., Postmaster-General.

SIR,

WE have the honour to submit the following report :—

INTRODUCTORY.

1. The Committee have held 41 meetings.

The terms of reference were as follows :—

“To enquire into the prevalence and causes of the disease known as telegraphists' cramp, and to report what means may be adopted for its prevention.”

A memorial to the Postmaster-General from the Postal Telegraph Clerks' Association has also been referred to the Committee. This memorial draws attention to the arrangements for instructing learners and the duties of junior telegraphists in the Central Telegraph Office, and to the effect which these may have upon the operators concerned. The Committee have, in connexion with this memorial, enquired how far the types of Morse key most generally in present use are responsible for nervous and muscular trouble.

Meetings.

Reference.

Memorial from the Postal Telegraph Clerks' Association.

METHODS OF ENQUIRY.

2. The Committee have had before them 17 officers (10 men and 7 women) who had difficulty in the manipulation of telegraph instruments, and have observed their working.

Observation of telegraphists who had difficulty in manipulation.

A Sub-Committee consisting of the two medical members of the Committee, Dr. Sinclair and Dr. Thompson, was appointed to enquire into the medical aspect of the disease. The report of the Sub-Committee is given in Appendix No. 1; and the Committee have accepted the views on the medical aspect of telegraphists' cramp expressed therein.

Medical Sub-Committee.

A circular was sent to all telegraphists (8,153 in number) employed in the Central Telegraph Office and in the larger provincial Post Offices where there is a separate staff for telegraph work, asking for particulars of any difficulty in manipulation experienced by each telegraphist. 7,317 replies were received and investigated by the Sub-Committee. The tabulated results are included in Appendix No. 1.

Circular to staff.

The Sub-Committee also examined personally all the available officers (148 in number) in one representative division of the Central Telegraph Office, and watched their sending. Mr. Davis, another member of the Committee, was present throughout these examinations on the invitation of the Sub-Committee, and the Sub-Committee also had the advantage of the advice and assistance of Mr. W. T. Smith, Telegraph Traffic Manager.

Personal examination of staff in one division of Central Telegraph Office.

3. The Committee have taken the evidence of witnesses whose position and experience qualified them to give evidence on the subjects referred. The witnesses included officers of the Headquarters' administrative and medical staffs, supervising officers of the Central Telegraph Office and of provincial telegraph offices, and representatives of the Postal Telegraph Clerks' Association. A list of the witnesses is given in Appendix No. 2.

Witnesses.

Collection
of evidence
by circulars.

The Committee have also collected written evidence from Controllers, Surveyors, Telegraph Traffic Managers, Engineers, Postmasters, Telegraph Superintendents, and other officers in the service of the Postmaster-General who were thought to be qualified to offer an opinion on telegraph matters; and the opinions of 514 officers have thus been obtained.

Enquiries
abroad.

Enquiries have been made of the telegraph administrations of Austria, Belgium, France, Germany, and Italy, and a report has been obtained from Mr. Newlands on the conditions in India. The reports will be found in Appendix No. 3. Enquiries have also been made of the Western Union Telegraph Company and of the Commercial Cable Company regarding the prevalence of cramp among the operators of the public telegraph companies in the United States of America and the general telegraph operating conditions there; and one member of the Committee (Mr. Purves) visiting America has obtained further information. A copy of Mr. Purves' report will be found in Appendix No. 4.

Trials of
telegraph
keys.

The Committee have also caused trials to be made of telegraph keys of different types and degrees of adjustment.

HISTORY OF TELEGRAPHISTS' CRAMP.

History
of tele-
graphists'
cramp.
Morse
working.

4. The history of telegraphists' cramp and the steps taken regarding it previous to the present enquiry may be briefly reviewed.

Telegraphists' cramp in this country is associated mainly with the use of the Morse instrument. In the early days of the telegraph service this instrument was less generally used than now. The Magnetic Telegraph Company used only "Bright's Bell" and "Single Needle" instruments, but the United Kingdom Telegraph Company and the Electric and International Telegraph Company used the Morse instrument to some extent. In August 1870, shortly after the transfer of the telegraphs to the State, 30 per cent. of the instruments in use were Morse. From that date the use of these instruments has increased, and they have gradually become the prevailing type: in 1907, 64 per cent. of the instruments in use were Morse. A few of the heavier circuits are now being worked with fast automatic instruments, and the volume of work carried by these is increasing; but on most of the circuits not worked with Morse instruments the traffic is lighter.

Early
references
to cramp.

5. Telegraphists who had difficulty in manipulation were not unknown in 1870 at the time of the transfer, but the difficulty does not appear to have been specifically referred to as telegraphists' cramp. A telegraphist who could not send on one kind of instrument would have been employed on other instruments or upon non-manipulative work, and hence his disability would not have come under further notice.

The earliest description of telegraphists' cramp as a specific disease was by M. Onimus* in Belgium in 1875. He gave a clear account of the symptoms, and associated the complaint with the use of the Morse key. He recommended alternating duties upon the Hughes and Morse instruments as a preventive measure.

In August 1882, Mr. Edmund Robinson,† M.R.C.S., surgeon to the General Post Office at Leeds, read a paper before the British Medical Association upon four cases of telegraphists' cramp. The cases are clearly described and it is noted that all were workers on the Morse instrument. Mr. Robinson points out the likeness of this complaint to the earlier and well recognized cases of writers' cramp. In the same year (1882) a report was made on telegraphists' cramp by the Chief Medical Officer of the Post Office. Two years later Dr. T. W. Fulton,‡ who had been a telegraphist in the Edinburgh Post Office, described the disease. Dr. Fulton, who appears to have had much experience of telegraphists' cramp, stated his belief that it was probably more common than was generally supposed.

Isolated cases have been reported by observers in several countries; and in 1903 an extensive monograph on the "occupation neurosis of telegraphists" was published by Dr. E. Cronbach.§ He describes 17 cases which he had observed in Dr. Mendel's hospital in Berlin, and points out that only three of these were Morse workers while 14 worked on the Hughes instrument. He shows clearly that there is a form of telegraphists' cramp due to continuous working on the Hughes instrument, and argues strongly that substitution of the Hughes instrument for the Morse would have no effect in preventing the occurrence of cramp among telegraphists.

* "Gazette Medicale de Paris," 1875, p. 175. † "British Medical Journal," 1882, Nov. 4th.
‡ "Edinburgh Clinical and Pathological Journal," 1884. § "Archiv für Psychiatrie," 1903, *ser.* 243.

6. In the British telegraph service attention was called from time to time to cases of cramp; but generally telegraphists who were unable to telegraph from any cause were employed on other duties which did not involve Morse manipulation. Few cases came under notice, and the disease was not considered to be prevalent enough to warrant general administrative action.

Cramp in the British telegraph service.

The increased use of Morse instruments already referred to made it increasingly difficult to find alternative work for telegraphists affected with cramp. Within recent years, too, it has been more and more insisted on that all operators should be able to take in turn all the duties proper to their class; and since 1905, in addition to an annual report upon the efficiency of officers who had not attained the maximum of their scale of pay, an annual report on those at the maximum has also been required. It thus became impossible for telegraphists who could not key to escape notice; many old-standing cases of cramp were brought under review, and the disease attracted more attention than before.

7. In 1906 the Workmen's Compensation Act came into force, providing for the payment of compensation to workmen disabled from following their employment through industrial diseases; and the Postmaster-General, at the suggestion of Mr. Robertson, M.P., directed that the Industrial Diseases Committee be asked to consider whether telegraphists' cramp should properly be added to the Third Schedule of that Act as a disease of occupation.

Workmen's Compensation Act, 1906.

8. It was not thought necessary by the Industrial Diseases Committee to do more than consider whether telegraphists' cramp was or was not outside the category of accidents or diseases already covered by the Act; whether it incapacitated from work for more than a week; and whether it was so specific to the employment that the causation of the disease or injury by the employment could be established in individual cases. Beyond this they had no concern with its prevalence, causes, or means of prevention.

Enquiries of Industrial Diseases Committee.

They examined witnesses from the Postal Telegraph Clerks' Association; and Dr. Sinclair gave evidence, mainly on the medical aspect of the disease, on behalf of the Post Office.

The Committee reported as follows:—"That the disease should be considered "specific to the employment is beyond question, and we are of opinion that it should "be added to the Schedule as a subject for compensation." The addition was made by Order of the Secretary of State, dated 2nd December 1908.

DEFINITION.

9. The earlier investigations already referred to had led to the expression of a variety of opinions, based on such evidence as was then available, upon the nature and origin of telegraphists' cramp. Some authorities have regarded it as a muscular disorder; others as a disease of the peripheral nervous system; others as a disease of the central nervous system.

What telegraphists' cramp is.

After careful consideration of these antagonistic theories of telegraphists' cramp, and examination of a number of telegraphists affected with the disease, the Committee accept the last-named view; namely, that telegraphists' cramp is a disease of the central nervous system, and is the result of a weakening or breakdown of the cerebral controlling mechanism in consequence of strain upon a given set of muscles.

The characteristic feature of the disease—implied by the term "cramp" itself—is an "involuntary violent and painful contraction of the muscles";* throughout the telegraph service such visible spasm is regarded as the mark of the disease, and telegraphists' cramp may be defined as a disease of the central nervous system characterized by visible spasm of hand ^{and} or arm during the manipulation of a telegraph instrument, and by impairment of the power of making the specific coördinated movements needed for such manipulation.

10. In its medical aspect, however, before any cramp or spasm is apparent, there may be a stage characterized by subjective symptoms only, when the operator feels pain or discomfort in the operating hand or arm. The pain is referred to various parts of the limb, but it is constant in its time of appearance—that is, it occurs when the operator begins to key or soon afterwards, before any muscular fatigue is possible; and this is the only circumstance which enables this pain to be distinguished from pain caused by fatigue. The operator's electrical reactions are normal, and his muscular and nervous condition, so far as can be ascertained, is normal in all respects;

Early subjective stage of cramp.

* Sir J. A. H. Murray's New English Dictionary.

and his work does not suffer. There is no visible cramp or spasm; visible cramp or spasm may or may not develop; and although this condition cannot therefore properly be called telegraphists' cramp, the Committee are of opinion that it marks an early stage of the disease.

Various forms of cramp.

11. Any instrument which calls for repeated fine muscular movements of the same kind may involve a relative "occupation spasm" or "craft neurosis." Thus, while we have associated the term "telegraphists' cramp" with the disease which brings about a difficulty in making the specific coördinated movements needed for a proper manipulation of the particular instrument known as the Morse key, the manipulation of the Baudot or Hughes keyboards may similarly bring about a relative form of cramp (analogous to pianists' cramp); and all these three forms of cramp are on parallel lines with writers' cramp.* All these diseases come under the same definition, but the nerve centres and muscles involved are in each case different. The various members of the group can be distinguished from one another by the fact that the pain and spasm occur only during use of the particular instrument on which the disabled worker has been employed, and disability in the use of one instrument does not necessarily imply disability in the use of any other instrument. A few exceptions to this general rule have been found in advanced or long-standing cases.

PREVALENCE.

Returns furnished to Industrial Diseases Committee.

12. In 1908, returns from local executive officers of telegraphists with manipulative disability had been laid before the Industrial Diseases Committee. Those returns showed that 4 per cent. of the telegraphists employed at offices with a separate telegraph staff were reported to be so affected, and after the exclusion of those whose disability was apparently due to other causes than cramp there remained 3·3 per cent. presumed to suffer from cramp. The returns from offices where the staff was employed partly on telegraph work and partly on postal work showed a proportion of 1·7 per cent. of telegraphists with manipulative disability, and a proportion of 1·3 per cent. with probable cramp.

The value of these figures is necessarily lessened by two considerations:—(1) they were obtained under conditions where an exact diagnosis was impossible, and (2) they included only cases of declared or officially observed disability; and there is reason to suspect that many telegraphists concealed their manipulative disability from fear of the consequences to their career, and that there was sympathetic connivance on the part of many supervising and executive officers.

For these reasons the figures could not be accepted by the present Committee as a complete guide to their own investigations; and it became necessary, in order to get as near as possible to the full facts, to proceed by new and different methods.

Methods of determining prevalence: (i) Cases of visible spasm.

13. Since telegraphists' cramp is characterized by visible spasm, it should be possible to determine by personal examination of the staff the number of telegraphists so affected. This personal examination should be conducted by a medical officer in conjunction with a telegraphic expert. The telegraphic expert would pick out telegraphists showing a bad style of manipulation, distinguishing those whose bad style is due to defective training or personal idiosyncrasy from those whose bad style is due to difficulty in sending; and the medical officer would distinguish those whose difficulty is due to cramp from those whose difficulty is due to local causes, such as muscular weakness, rheumatism, or neuritis, or to generalized diseases of the nervous system which might simulate cramp.

(ii) Cases in the subjective stage.

To detect cramp in the early subjective stage must be more difficult. The medical officer must needs trust the good faith of the telegraphists concerned; and to detect malingering his medical skill must be supplemented by his general shrewdness and knowledge of men. There might often be no reason to doubt a telegraphist's statement; but a neurasthenic telegraphist might believe difficulties to be real which exist only in his imagination, and occasionally a telegraphist who wished to give up operative work might feign the symptoms of cramp.

Impossibility of examining whole staff.

Subject to these limitations, a personal examination of the whole staff would doubtless be the most effective means of finding out with certainty the prevalence of

* Writers' cramp is also a disease of telegraphists, for telegraphists have to write down the message no less than to send it; and those afflicted with the one disease may be afflicted with the other also.

the disease. But for practical reasons this course was impossible; and four methods of enquiry suggested themselves which, although less exhaustive, might enable a trustworthy estimate to be made:—

- (1) To ascertain, by personal examination of a single selected representative office, the number of telegraphists in that office affected with cramp, and to regard that as an index of prevalence throughout the country.

This method was felt to be too arbitrary and hazardous, if taken alone, to offer a safe guide to trustworthy conclusions.

- (2) To make confidential enquiries through local service channels as to the number of cases in each locality.

This method was discarded as probably leading to incomplete results.

- (3) To obtain statements compulsorily from the staff by official requisition.

This method was regarded as unlikely to produce true information.

- (4) To invite voluntary statements from the staff, to be addressed direct to the Committee.

This method was finally adopted; and it was further decided to check the accuracy of the replies by a direct personal examination of a small section of the staff.

14. A circular with a set of questions to which answers were invited was sent to each of the 8,153 telegraphists employed either in the Central Telegraph Office or on the telegraph side of the large provincial offices which have a separate telegraph staff. Every possible precaution was taken to inspire confidence and ensure the trustworthiness of the answers, which were to be sent back under cover to the Secretary of the Committee; and it was left open to the telegraphists to sign the answers or not as they preferred. A copy of the form employed is included in Appendix No. 1.*

Methods adopted by Committee. Issue of circular to staff.

Answers were received from 7,317 telegraphists, or 90 per cent. of the staff approached; and slightly over three-quarters of the answers were signed.

The Committee appreciate the fact that so many as 90 per cent. of the telegraphists concerned were willing to coöperate in their investigations in this voluntary way, and that most of the answers received were evidently made with the greatest wish to give full and correct information.

The answers from the "F" Division of the Central Telegraph Office were first examined and tabulated. The Committee chose this Division as representing a mean between those Divisions where Morse working is predominant and those where little Morse working is done. One hundred and fifty-five telegraphists (out of 182) answered the questions asked, and 100 made complaint of difficulty in keying. This proportion proved to be much in excess of the average over the whole country. Of the 100 complaints, 14 suggested cramp proper, 19 an early subjective stage of cramp, and 67 muscular fatigue or other causes of difficulty.

One hundred and forty-eight telegraphists of this Division—that is, all who were available—were then personally examined, and 93 were found to have some difficulty in keying. Of these 7 were found on the tests† applied by the Sub-Committee to be actually affected with cramp, 6 to be in the early subjective stage, and 80 to have muscular fatigue or other causes of difficulty. Not one of the officers was disabled from doing his allotted duty. The two practical telegraphic experts who were present at the examinations concurred, so far as they were concerned, in these figures.

Personal examination of staff of "F" Division of Central Telegraph Office.

A comparison of the results obtained by the scrutiny of the written answers with the results obtained by the personal examination of the staff shows a fairly close agreement as regards complaints of difficulty, but a wide discrepancy in the number of officers affected with cramp (7 cramp cases as against 14, and 6 subjective cases as against 19). This discrepancy becomes less serious than would at first appear when allowance is made for the difficulty of diagnosing a great variety of minor symptoms from written replies, and for a natural tendency, especially on the part of those most affected, not to understate their symptoms. The ascertained results in the "F" Division are based on so small an actual number of operators that it would be unwise to regard them as indicating the conditions prevailing in the Central Telegraph Office as a whole, or to press them into any use except as a check upon the written answers from the "F" Division.

The replies from the rest of the staff were read and tabulated by the Sub-Committee after their personal examination of the "F" Division had taken place. The experience gained in that examination helped the Sub-Committee in differentiating between real and apparent cramp symptoms in the written replies; and the Committee are satisfied

* See page 50.

† See Report of Medical Sub-Committee, Appendix No. 1, page 37.

that a stricter diagnosis was applied in the general tabulation, and that, although personal examination of the whole staff would show a smaller proportion to be affected with cramp than was shown by the scrutiny of the written answers, no deduction should be made at all corresponding to the drop in the proportion ascertained in the "F" Division.

Analysis of answers to circular.

15. The analysis of the answers received, excluding the "F" Division of the Central Telegraph Office, is given in the following statement:—

		Complaints of "Difficulty" in Keying.						No Complaints.		Total.
		Complaints suggesting "Cramp."		Complaints suggesting early subjective stage of Cramp.		Complaints suggesting Muscular Fatigue or other causes of Difficulty.				
		Number.	Per-centage.	Number.	Per-centage.	Number.	Per-centage.	Number.	Per-centage.	
Forms signed	Men	177	4·8	41	1·1	1,060	28·8	2,406	65·3	3,684
	Women	42	2·4	15	·8	420	23·8	1,291	73·0	1,768
Forms unsigned	Men	68	9·5	11	1·5	406	56·5	234	32·5	719
	Women	26	2·6	24	2·4	474	47·9	467	47·1	991
Total	Men	245	5·6	52	1·2	1,466	33·3	2,640	59·9	4,403
	Women	68	2·5	39	1·4	894	32·4	1,758	63·7	2,759
Grand Total		313	4·4	91	1·3	2,360	32·9	4,398	61·4	7,162

The figures show that over one-third of the staff profess to feel more or less difficulty in manipulation; but it is necessary to emphasize the fact that in most cases the difficulty is slight, of a temporary character, and attributable to muscular fatigue alone. Such fatigue is incidental to muscular work of all kinds.

The number of telegraphists whose statements suggest that they suffer from "cramp" represents 4·4 per cent. of those who answered the enquiries, and there are also 1·3 per cent. who appear to be in the early subjective stage: a total of 5·7 per cent. The Committee are of opinion, for the reason already given, that the percentage of telegraphists throughout the service actually suffering from cramp in its various stages is appreciably less than the figures quoted above; but they are satisfied that the number of cases is such as to call for the serious consideration of definite methods of prevention and relief.

Relative prevalence among male and female staffs.

16. The percentage of telegraphists whose complaints suggest fatigue is nearly the same among the male staff as among the female staff, and this is also the case in the complaints suggesting cramp in an early subjective stage. The proportion of complaints suggesting actual cramp, however, is more than twice as great among the male staff (5·6 per cent. to 2·5 per cent.). The Committee attribute this difference not to less susceptibility in women to cramp but to the fact that (among other causes) a large proportion of female telegraphists leave the service after a much shorter period than male telegraphists for marriage or other reasons.

Prevalence in relation to length of service.

17. It has been hitherto held that practically no cases of cramp occur in the early years of service. The Committee have reason to think that this is by no means universally true; but they do not consider that the figures available are conclusive enough to show that there is any one period at which cramp is more prevalent than at others. A cramp subject is liable to attack at any point in his telegraphic career.

Prevalence in amalgamated offices.

18. The Committee have not obtained returns from the staff employed partly on postal work and partly on telegraph work at "amalgamated" offices. Enquiries have shown that all officers employed on telegraph work are liable to cramp, however small the amount of that work may be; and the relation between the liability to cramp and the amount of telegraph work performed is explained more fully below. But the returns furnished to the Industrial Diseases Committee suggest that the incidence of cramp amongst officers at "amalgamated" offices is less than half that amongst officers employed solely on telegraph work; and in view of the diversity of the conditions prevailing at "amalgamated" offices the Committee did not think it necessary to attempt a closer estimate.

19. Most of the telegraphists affected with cramp are still performing ordinary telegraph duties notwithstanding the difficulty experienced; and it is found that a telegraphist may continue for years to do work that will pass muster in spite of severe cramp, obtaining relief by working more or less slowly, by varying the method of manipulating the key, or by resorting occasionally or regularly to the use of the left hand. An operator affected with cramp in the right hand is very often able to use the left hand for months or years, but in some cases the left hand becomes affected eventually.

Cramp subjects not necessarily disabled from performing ordinary duties.

20. Although telegraphists may suffer from cramp as a result of working on any telegraph instrument, no case of cramp arising from the use of any instrument except the Morse key has come under the notice of the Committee. It must be observed that the use of the Hughes and Baudot instruments is comparatively limited, and that the latter has been worked in this country only within the last few years.

No case of cramp other than Morse cramp observed by Committee.

The Committee further consider that Morse workers are more liable to cramp than workers with either the Hughes or Baudot instruments, as the muscular contractions required for the manipulation of the Morse key are more limited in range and character, and are performed at a higher speed (*see* paragraph 47).

Greater liability of Morse workers to cramp.

21. No statistics showing the prevalence of telegraphists' cramp were included in the replies received from Austria, Belgium, France, Germany, and Italy; but the telegraph administrations in these countries declared the number of telegraphists affected to be very small.

Prevalence in foreign countries.

In the United States of America* the telegraph business is mainly in the hands of two companies, the Western Union Telegraph Company and the Postal Telegraph Company. The former operates over the whole country in large and small offices, but the latter does not extend its service to small towns and villages. The operating staff is not permanently employed, but is increased or reduced to meet the requirements of the work. The telegraphists make frequent changes on their own account, and their average period of employment at any one office is comparatively short. The controlling officers of both companies gave Mr. Purves every possible assistance; but no definite statistics were available, and an idea of the prevalence of telegraphists' cramp could be obtained only by collecting the opinions of the supervising staff.

From the information obtained in this way the percentage of operators showing symptoms of cramp would seem to be about 4 per cent. in the Western Union Company and about 10 per cent. in the Postal Company. Both men and women are understood to be affected in about the same proportion.

CAUSES.

22. In the opinion of this Committee, the nervous breakdown known as telegraphists' cramp is due to the combination of two factors, one a nervous instability on the part of the operator, and the other repeated fatigue during the complicated movements required for sending messages† by hand on a telegraph instrument. Fatigue is essentially different from cramp, and a person of average health can suffer fatigue again and again indefinitely without becoming affected with cramp; but if a nervous instability exists, fatigue cannot be prolonged beyond a certain point without causing cramp. This point depends on the nervous constitution of the subject, and varies not only in different persons but in the same person at different times according as the nervous "tone" is affected by general health or other conditions. In extreme cases, a very small amount of manipulation may induce fatigue which may lead to cramp in a subject who is unfitted for telegraph work; or again the breakdown may not occur until after many years of heavy work.

Cramp due to two factors.

Thus the amount of fatigue required to cause cramp is governed solely by the personal factor, and has no constant relation to the amount of work performed.

23. A lack of appreciation of this dual nature of the cause of cramp has led to a great diversity of opinion among those who have hitherto studied this subject.

Cramp has been attributed to the following causes:—

- (a) constitutional weakness;
- (b) inaptitude for telegraph work;
- (c) the nature and amount of a telegraphist's work and the conditions under which it is done;

Causes to which cramp has been attributed.

* *See* Mr. Purves' report, Appendix No. 4.

† This process is known in the service, and is referred to elsewhere in this Report, as "sending" or "keying."

- (d) bad style of manipulation ;
- (e) too early responsibility ;
- (f) heavy manual work ;
- (g) construction of Morse keys ;
- (h) inadequate working accommodation.

The Committee do not consider that any one of these things can properly be regarded as a primary or sole cause of cramp ; but they may be secondary causes so far as they tend to produce nervous instability or fatigue.

(a) *Constitutional Weakness.*

Constitutional weakness.

24. The fact that telegraphists' cramp affects only a small portion of the staff, and that the telegraphists affected are not generally those who have performed most telegraph work, has led many persons to think that cramp is due to some constitutional weakness. This weakness has been thought by some to be physical, by others to be nervous, according to the view taken of the nature of cramp.

The cramp subjects seen by the Committee included strong and otherwise healthy persons ; and no sufficient reason is seen to connect cramp directly with physical weakness, although a person of poor physique may be specially liable to fatigue. A considerable proportion were of a nervous temperament, but in some of these cases the nervous condition showed itself after they had become affected with cramp. The Committee are unable to find any necessary connexion between the nervous instability which is a partial cause of cramp and general nervous weakness, but it is not unusual for the one to develop from the other. It cannot be said that a telegraphist with no obvious neurasthenic tendency will remain free from cramp, nor on the other hand, that a telegraphist who has such a tendency will necessarily be affected ; but the Committee are of opinion that there is greater liability to cramp on the part of neurasthenic persons.

(b) *Inaptitude for Telegraph Work.*

More persons wanting in aptitude for telegraph work appointed now than formerly.

25. Many of the older telegraphists are of opinion that cramp is more common now than in the early days of their service, and that the increased prevalence is due, in part at least, to changes in the method of recruitment which have resulted in the appointment of a larger proportion of persons who have no aptitude for telegraph work.

Formerly candidates came either from outside or from among telegraph messengers. They were, as a rule, employed as indoor messengers to collect or distribute telegrams in the instrument rooms ; and in their spare time they were allowed to learn and practise on any disengaged instrument, getting a helping hand as they could. They knew that they must qualify somehow, and that future employment and advancement depended on their own efforts. If they found that they had no aptitude or adaptability they sought some other walk in life before they became committed to a telegraphist's career ; and the weaklings or inapt learners fell out by the way without being put forward for nomination, or, if nominated, were not employed upon manipulative work. A qualifying general examination was passed before a Civil Service Certificate was awarded ; but this was after the lads had learnt telegraphy and been chosen for nomination.

Now, a competitive examination of a purely general character takes precedence of practical experience. The examination once passed, the appointment is often supposed to have been made secure and to depend no longer upon the candidate's own efforts. Every successful candidate is appointed "Learner"* whether he has any real aptitude for operative telegraphy or not, and without any evidence of temperamental fitness for telegraph work ; and, once appointed Learner, an inapt recruit is seldom got rid of unless his incapacity is extreme. By special attention on the part of instructors, few inapt Learners fail to be brought to the minimum standard of efficiency required for appointment to the establishment ; but the excessive strain in such cases of inaptitude to attain even this stage weakens the operator, and sooner or later is likely to lead to cramp.

Inaptitude may lead to cramp.

Recruitment by competitive examination.

26. The Committee are satisfied that telegraph work may cause great fatigue and strain in persons who have no aptitude for it, and that such persons are specially liable to cramp.

The Committee can find no direct connexion between telegraphists' cramp and recruitment by competitive examination. This method of recruitment, in so far as

* The method of appointment is explained more fully in par. 51.

the competition is open, does not admit of previous discrimination between persons who may or may not have aptitude for telegraph work; but the regulations make ample provision for dispensing with the services of Learners who fail to show aptitude. The Committee find, however, that these regulations have not been strictly enforced in practice, and that Learners have been allowed to pass into the permanent establishment whom it would have been better, in their own interests as well as in those of the telegraph service, to have rejected. The Committee are satisfied that there would have been fewer cases of cramp among the junior members of the staff if greater strictness had been shown in this respect.

Inaptitude may be temperamental or physical; and the age at which a learner begins to learn is an important factor.

The sooner after the age of 14 a learner begins telegraphy, the more easily he will learn and the greater will be the prospect of his becoming a good telegraphist. An apt and intelligent learner beginning at any age between 14 and 17 should prove a success; but after 17 the difficulty of learning steadily increases, and a learner entering at the age of 25 can hardly hope to become expert.

Similarly, persons who have been employed for many years at small offices where little telegraph work is required of them often prove unequal to continuous telegraph work at large and busy offices.

The Committee find that persons who do not begin telegraphy until they are too old to become expert, and those who are transferred from small to large offices when they are too old to adapt themselves to the new conditions, are especially likely to break down with cramp.

The Committee have given extended study to the general question here raised of the admission and tuition of telegraphists, and their recommendations will be found in paragraphs 51-64.

(c) *Nature and Amount of a Telegraphist's Work, and the Conditions under which it is done.*

27. The arduous and exacting nature of a telegraphist's work was put forward as a cause of cramp by the Postal Telegraph Clerks' Association in their evidence before the Industrial Diseases Committee in 1908. To show the physical and mental strain of the work upon an operator, it was explained that in sending at the rate of 25 words a minute 22,500 clearly defined signals per hour had to be made. The figures were said to be not uncommon, though they amount to 71 messages an hour; and it was contended that so unnatural and continued a stress could result only in nervous and physical deterioration. To make matters worse, the Post Office was said to be urging the staff to a greater and greater output of work, and the increased pressure on the operators had resulted in an alarming increase in the number of cases of cramp.

Evidence
of Postal
Telegraph
Clerks'
Association.

Representatives of the Association were invited to submit a statement and give evidence on this subject before the present Committee. Less stress was then laid on the arduous and exacting nature of manipulation and on the number of signals sent every hour; and it was admitted that the figures quoted above were merely fancy figures and that the calculation was of little practical value. Although still regarding cramp primarily as muscular failure, the Association attributed this muscular failure to the mental strain caused by the harassing methods of the Post Office in its endeavours to obtain higher rates of working, and to a constant fear in telegraphists' minds of the results to themselves, should they fail to meet the demands upon them.

28. The official method to which the strongest objection was taken was that described as the "average system," whereby, it was alleged, the Post Office was trying to obtain an average of 24 messages an hour per operator at every office without regard to local conditions or to the fluctuations of the traffic. To obtain this average, the staff of an office was alleged to be reduced to a minimum, circuits to be closed down prematurely, and simplex* (up and down) working, which was said to be more trying to an operator than duplex working,* to be resorted to excessively. A telegraphist was thus always working under pressure; he knew that an average had to be maintained; and, besides his own output, he had to carry on his shoulders the output of all his colleagues. The Committee were urged, as the first and main step towards the prevention of cramp, to abolish this average system which was attended by such disastrous results.

Average
system.

* For explanation of the terms "simplex" and "duplex," see paragraph 38.

In examination, the Association representatives admitted that they had no knowledge of official instructions respecting the average system, and that they could not say definitely what the system was. They had no objection to the Post Office taking averages, provided that no use was made of them, as they believed use was made, to force up the individual output, to compare one office with another, or to keep the staff below the requirements of the work. They regarded the operator average of 24 as being excessive for the whole staff of an office throughout the day (8 a.m. to 8 p.m.); but the objection was not so much to the operator average being fixed at 24 as to the use of any average at all as a basis of comparison between operator and operator, or between office and office. The mere knowledge that an average had to be attained caused unnecessary strain, whatever the average might be, and whether the work to be done was manipulative or not; and the staff generally were under the impression that an average had to be maintained, although nothing definite had ever been said to them on the subject.

29. In view of the importance attached by the Postal Telegraph Clerks' Association to this aspect of the matter, the Committee have investigated it somewhat fully. Evidence was given by Mr. Grant, Second Class Clerk, Higher Division, Secretary's Office, and by Mr. W. T. Smith, Traffic Manager, about the administration of the so-called "average system"; detailed statements were obtained of the work performed by the telegraph staff during an ordinary day at Liverpool and at Leeds and in three divisions of the Central Telegraph Office; and Mr. Sanderson, Postmaster of Leeds, and Mr. Surmun, Chief Telegraph Superintendent of Liverpool, and Messrs. Willshire and Coates, Assistant Controllers, Central Telegraph Office, were examined by the Committee. With the exception of Mr. Grant, all these officers have been telegraphists, and Messrs. Surmun, Willshire, and Coates have devoted their whole official life to telegraphy.

Telegraph
annual
returns.

30. The witnesses explained that many offices were formerly overstaffed and that working rates were very low; and to provide a check on the working of an office, periodical returns—now annual—had been instituted, giving details of the traffic and of the staff during one complete week in the year. There must be some more or less definite quantitative relation between work and staff; and it had been found that, with normal conditions of traffic and effective supervision, an average of 24 messages per operator per hour was a reasonable standard to be aimed at. This was not a fixed standard; considerable elasticity was allowed, and the general conditions of each office were carefully taken into consideration. If the average fell much below 24 in any office of medium or greater size and there were no special circumstances in connexion with the local traffic to account for it, it suggested that the staff was not properly adjusted to the work, and that the superintending officers had not exercised proper organizing powers. The whole arrangement, indeed, was said to be a check on the organizing ability of the superintending staff; it related to the traffic and staff of an office as a whole and not to individual telegraphists. A telegraphist was placed in charge of a circuit where he was expected to deal to the best of his ability with the work as it came along. In a properly organized office any circuit habitually carrying little traffic would be put on a "concentrator";* but if the work at a circuit not on a concentrator chanced for the time to be light, the telegraphist would have little to do. He was not concerned with any average at his own circuit, still less with the averages at other circuits in the office; and none of the superintending officers who attended before the Committee had known of any telegraphist troubling himself or being troubled about such a matter.

31. After a full survey of the facts and evidence offered on both sides of this question, the Committee find that the telegraph annual return is primarily statistical in its nature and is used for the purpose of improvement of organization, and that the object of the return is to set up a standard to be aimed at at all offices throughout the country. The Committee cannot find anything unreasonable in the collection of statistics for this purpose. They are satisfied that the return does not aim at, and is not used for, any comparison between individual operators, and that it need therefore give no ground whatever for apprehension, fear, or anxiety on the part of any member of the staff; and they are further of opinion that the issue of an official statement explaining the use of the annual return would be beneficial, and serve to remove any misapprehension that may exist regarding it.

* A concentrator is a small switchboard by means of which a number of circuits can be brought together or "concentrated" at one point, and the work distributed amongst a smaller number of operators than there are circuits.

32. A standard of 24 messages an hour was agreed to by the Telegraph Conference of 1907, and was assented to by the Postmaster-General (Mr. Buxton) on condition that a considerable amount of elasticity should continue to be recognized, especially in regard to some of the large offices, and that "the standard rate should not be obtained at the cost of delay or excessive overtime in the season of pressure." Standard of 24 messages an hour.

The Committee find that due regard is paid to all considerations which differentiate one office from another. In the majority of large offices the standard of 24 messages an hour is not attained. The annual return is examined at headquarters; and, where the circumstances of the case are found to explain and justify the results attained, the return is accepted year by year in spite of the fact that the standard is not reached. The Committee have enquired similarly as to the action taken where an abnormally high average is revealed by the return. Such a result is not necessarily to be regarded as indicating undue pressure on the operator. The simplicity of the messages handled, undue delay in transmission, an ample and regular flow of traffic, exceptional organization in an office, or skilled application in the operators, may all aid in accounting for the high average secured. But an equally strong presumption exists for investigation before the return is passed. The Committee cannot find that any undue or harassing pressure is intentionally brought to bear upon the staff by the supervising officers. They are informed, however, that it is possible for a postmaster or surveyor to ascertain the working average of an office on any day in the year; and they would recommend that these officers be explicitly empowered and encouraged to do so frequently, in order that any possible case of undue stress upon a staff may be dealt with promptly.

All the witnesses agreed that 24 messages an hour as an individual average presented no difficulty, and that, if there were sufficient work, an expert operator could easily send many more than this. The Committee concur in this opinion. The average number of words in a message is between 20 and 21 (including preamble), and 24 messages an hour, if sent at a rate of 20 words a minute, represent about 25 minutes actual manipulation of the key per hour, not allowing for acknowledgments, repetitions or corrections.

33. Particulars of the Morse sounder working at Leeds, Liverpool, and three divisions of the Central Telegraph Office on an ordinary day between 8 a.m. and 8 p.m. are given in the following statements, which summarize the information obtained from these offices. Returns of Morse sounder working.

STATEMENTS summarizing particulars of MORSE SOUNDER WORKING between 8 a.m. and 8 p.m. in the "D," "F," AND "K" DIVISIONS of the CENTRAL TELEGRAPH OFFICE on the 10TH MARCH 1910, and at LEEDS and LIVERPOOL on the 5TH APRIL 1910.

I.—HOURS of DUTY and OPERATOR AVERAGES.

Office.	Total number of hours of telegraphists' duties in day period (8 a.m.—8 p.m.).		Average rate of working at Morse circuits during day period (messages per hour).	Number of hours of Morse sounder working during which the working rate per hour reached 24 or more.
	Morse sounder operating (sending and receiving).	All other work.		
1.	2.	3.	4.	5.
C.T.O., D Division - - -	437	634	23·4	137
" F " - - -	571	398	23	221
" K " - - -	814	272	24·9	367
Leeds - - - -	782	530	24·1	387
Liverpool - - - -	1,429	1,243	20·1	387

II.—STAFF EMPLOYED.

Office.	Number of telegraphists on duty between 8 a.m. and 8 p.m.	Number of telegraphists on duty for at least four hours within the day period (8 a.m.—8 p.m.).	Number of telegraphists employed at Morse sounder working for at least four hours within the day period.	Number of telegraphists whose duty within the day period consisted solely of Morse sounder working.
1.	2.	3.	4.	5.
C.T.O., D Division - - -	148	148	65	41
" " - - -	135	135	84	64
" " - - -	146	146	125	120
" " - - -	180	161	95	61
" " - - -	379	358	185	117

III.—NUMBER of TELEGRAPHISTS employed on MORSE working for not less than FOUR HOURS, whose rate of working averaged 24 or more MESSAGES an HOUR throughout the DUTY, HIGHEST AVERAGE attained, and HIGHEST NUMBER of MESSAGES dealt with, by individual TELEGRAPHISTS.

Office.	Number of telegraphists employed at Morse sounder working for at least four hours in the day period who had an average of 24 or more.	Ratio (percentage) of telegraphists shown in Col. 2 to those on duty for at least four hours in the day period (see Col. 3, under II.).	Ratio (percentage) of telegraphists shown in Col. 2 to those employed at Morse sounder working for at least four hours in the day period (see Col. 4, under II.).	Highest average attained (per hour).	Highest number of messages dealt with by one telegraphist within the day period.		
					Messages.	Hours.	Average.
1.	2.	3.	4.	5.	6.	7.	8.
C.T.O., D Division -	22	14·8	33·8	*37·5 for 4½ hrs.	214	7½	28·5
" F " -	28	20·7	33·3	32 " 4 "	217	9½	22·8
" K " -	45	30·8	36	35 " 5½ "	258	7½	34·4
Leeds - - -	48	29·8	50·5	37·7 " 4½ "	320	9½	33·6
Liverpool - - -	56	15·6	30·2	44·7 " 5½ "	284	7½	37·8
				35·4 " 5 "	268	9½	29·2

* 78 Accountant-General's service messages between hours of 1 and 2 p.m.

Morse sounder working in America.

34. Particulars have been obtained of the output of Morse telegraphists in America, with which these figures may be compared. (See Mr. Purves' report, Appendix No. 4.)

In the New York office of the Postal Telegraph Company the average daily number of messages dealt with during the month of April 1911 by each of eight telegraphists employed for nine working hours a day on four of the busier duplex circuits on which a bonus is paid for rapid working was 438, representing an operator average of 48·6 messages an hour. The highest number of messages dealt with by one telegraphist during his nine hours' duty was 772, representing a working rate of 85·7 messages an hour; and a total of 500 messages or more on one duty was attained 85 times during the month.

In the New York office of the Western Union Telegraph Company the highest total reached in a day by any one operator during the month of May was 452, representing an average rate of working of 50·2 messages an hour.

The average number of words in a message in the United States is said to be from 30 to 32 as compared with 20 words in this country.

Rate of working of young telegraphists.

35. In this connexion may be cited the number of messages dealt with in an hour under favourable conditions by young telegraphists at the end of their training.

It had been suggested to the Committee that the number of public messages a learner could send and receive in one hour would be a better criterion of his qualification than the number of words he could send and receive in one minute; but there was a wide difference of opinion as to the number of messages with which a qualified Learner could be expected to deal. Arrangements were therefore made at the Central Telegraph Office and seven other large offices to set six male and six female Learners who had recently qualified to show how many messages they could deal with in one hour. Where enough qualified Learners were not available, the last appointed Telegraphists were taken. The average service, including the time spent in the school, of the 96 operators concerned was 1 year 8 months. The tests were made in the schools, in order not to interfere with business; but copies of real messages were used, and the conditions were made as far as possible the same as at circuits working "up and down." There was a plentiful supply of messages, and the operators were required to send and receive as many as they could. No standard was mentioned to them, and they were told that greater importance was attached to steady and accurate sending than to speed. The highest number of messages sent and received by one officer was 62, with 11 repetitions and corrections (this officer had had nearly three years' service), and the average of 96 officers was 43·4 messages with 5·5 repetitions and corrections.

General rate of Morse working not excessive.

36. In the light of these figures showing what telegraphists are capable of doing, the Committee cannot regard the general rate of Morse working, as shown by the returns from Leeds, Liverpool, and the "D," "F," and "K" Divisions of the Central Telegraph Office, as excessive. Little more than a third of the telegraphists

not less than four hours' Morse working maintained an average of 24 or more messages an hour throughout the duty; and the highest averages attained, and the highest number of messages dealt with, fall far short of what an expert Morse telegraphist is capable of doing.

After careful consideration of all the evidence, the Committee are of opinion that the amount of work actually done by telegraphists in this country is not excessive or likely to cause undue strain; and that it should have no ill effects on a telegraphist of normal nervous stability.

37. Enquiry was made as to the arrangement of duties at the offices from which witnesses were examined. The arrangements at these offices were said to be typical of all large offices. The duties are arranged in rounds or groups, and the duties in each round or group are varied as much as possible in respect of their time of attendance, and the proportion of manipulative to non-manipulative work. Telegraphists with increasing service and experience advance from one round to another; and, with a few exceptions, the work in the various rounds is so arranged as to be progressive in importance. The more important non-manipulative duties are generally included in the senior groups, as these duties are in some respects similar to those of overseers, and give opportunities to the senior men to learn the higher duties and qualify for promotion. The less important non-manipulative duties are distributed as far as possible among the various groups; but since about two-thirds of the work is manipulative, and some of the non-manipulative duties require a certain degree of specialization for their efficient performance, the distribution must necessarily be somewhat unequal. Although the groups of duties are more or less progressive in importance, it was shown that in practice the heavier Morse circuits were not, and could not be, restricted to the senior men. The heavier Morse circuits do not vary much in importance, and officers of five years' service and upwards take any of these circuits as required. The evidence indicated that the greatest consideration is shown to the staff in so arranging the duties as to equalize the pressure of work, and afford as much variety as circumstances admit.

Arrange-
ment of
duties.

38. Ordinary telegraph circuits may be worked "simplex" or "duplex." In "simplex" working, a telegraphist generally sends and receives alternately; and the frequent changes from sending to receiving give variety to the work, and should tend to prevent fatigue. In "duplex" working, one telegraphist sends continuously, and a second telegraphist receives continuously, so long as there are messages to be dealt with; and it has been contended that continuous sending for long periods is apt to cause fatigue and to lead eventually to cramp.

"Simplex"
and
"duplex"
working.

"Duplex" working is mainly limited to the busier hours of the day, and comparatively few circuits are worked duplex throughout the day. Sending and receiving telegraphists are at liberty to change places, and often do so; and it is not usual for a telegraphist to do the same kind of work for many hours at a stretch.

39. There are, however, a few duties, such as those at "special" wires between the London and country offices of provincial newspapers, where the traffic is all in one direction. The duty at the London end of these wires consists of sending only; a bonus is usually given by the newspaper proprietors for each column of matter telegraphed in excess of a given number of columns, in order to encourage a high rate of speed and to ensure the transmission of a maximum amount of copy; and the duty is generally regarded as exceptionally heavy. The representatives of the Postal Telegraph Clerks' Association stated in 1908, before Mr. Herbert Samuel's Industrial Diseases Committee, that the "special wire" telegraphists—in all cases picked telegraphists—were employed on sending throughout their whole period of duty; and that, actuated by a wish to get the bonus, a large number of the men, "splendid operators," contracted cramp through over-exertion, and that the Post Office had forbidden the bonus either to be offered or received, because it had found that the undue pressure set up cramp.

Work on
newspaper
"special
wires."

The Committee have made enquiry into the amount of work performed on these wires, and the incidence of cramp among the telegraphists employed in sending on them. The duty extends throughout the night from 6.0 p.m. to 6.0 a.m., and is divided into two attendances, from 6.0 p.m. to 2.0 a.m. and from 2.0 a.m. to 6.0 a.m. Each telegraphist takes the first and second attendance in alternate weeks. Telegraphists used to remain on these duties indefinitely; but in 1894 the period of employment was limited to five years; and this period was reduced to four years in 1902, and to three years—the present period—in 1906, to enable a greater number of

telegraphists to share the privilege. The duty is much sought after, and telegraphists show much reluctance to be removed from it.

Returns of
"special
wire"
working.

Returns of the work done on two typical or average "special wires" were taken on the 26th and 27th of October 1910, when Parliament was not sitting, and on the 30th and 31st of May 1911, when Parliament was sitting and business of general interest was under discussion in the House.

The return taken in October showed that during the first attendance less than four hours' keying was done on each wire, and during the second attendance there was only three quarters of an hour's keying on each wire. The average rate of keying was 21·5 words a minute (five letters to a word).

The return taken in May showed that during the first attendance 5 hours 14 minutes' keying was done on one wire and 4 hours' keying on the other, and that during the second attendance there was 1 hour 35 minutes and 39 minutes' keying respectively. The average rate of keying was 23·6 words a minute.

The returns suggest that, under normal conditions, the duty is not so arduous as has been represented. The sending is not continuous throughout the whole period of duty, and, especially during the second attendance, there are long intervals with nothing to do. At the same time, so far as the first attendance is concerned, the amount of keying is much more than would be done on any ordinary telegraph duty.

Payment of
bonuses.

When the representations quoted above were made to the Industrial Diseases Committee, the Postmaster-General had not forbidden the payment or receipt of bonuses. Such a course had been considered, but as the staff and the newspaper proprietors were alike in favour of the practice, the Postmaster-General had decided not to interfere. As a result of these representations, steps were taken to stop the practice, but met with strong opposition. The newspaper proprietors affirmed that none of the "special wire" telegraphists had cramp, and that they had never known a case of cramp to occur among them; and, as the Postmaster-General after enquiry could find no evidence that the work had caused injury to the health of the staff, the payment of bonuses was allowed to continue.

Prevalence
of cramp
among
"special
wire" tele-
graphists.

Since 1902, the earliest date from which staff records are available, 102 telegraphists have been employed on "special wire" duties; and 27 telegraphists are also known to have done the duty before 1902, some of them for as long as 15 years. The Committee have enquired into each of these 129 cases, and two only have been found who have had difficulty in keying either whilst employed at a special wire or since withdrawal from the duty.

The "special wire" telegraphists are selected because of their manipulative skill, which could not have been attained if they had not had aptitude for the work; and no doubt their comparative immunity from cramp is largely due to this fact; but the enquiries would seem to confirm the opinion held by many experienced telegraphists that the officers who do the heaviest duties are not those who break down with cramp, and to show that the longest period of continuous sending a telegraphist may have to do on ordinary duties, as distinguished from these "special wire" duties, should have no ill effect.

Staffing of
offices.

40. The telegraph annual returns are taken at a time of year when the traffic is about the mean, and they afford a criterion of the staff required for the work.

The Committee find that, so far as the evidence before them shows, the staff is provided for the average requirements of the traffic at a mean period of the year, and that an arrangement of this kind is essential for the proper organization of a business undertaking such as the telegraph service. The Committee cannot find that there is anything in the normal staffing of offices that has any direct bearing upon telegraphists' cramp.

Overtime.

41. The Committee have also considered the question of overtime as a cause of fatigue. Overtime is mainly done during the busier months of the year, June, July, August, and September, and during this period last year the overtime done by the male staff in the Central Telegraph Office averaged less than half an hour a day for each officer, and few officers did more than an hour a day on an average.

The Committee do not consider the amount of overtime worked to be excessive or likely to cause undue fatigue.

(d) *Bad Style of Manipulation.*

42. Some of the witnesses considered that a bad style of sending leads to cramp; and this view was shared by many of the officers who replied to the circulars issued. Other witnesses were of opinion that the bad style of sending usually seen in cramp subjects is rather the result of the cramp than its cause. Style of manipulation.

In the opinion of the Committee there is much to be said for both these views. A bad style may produce great fatigue and hasten the breakdown which culminates in cramp; and a telegraphist with a good style who suffers such breakdown may send irregularly in order to get relief. It is difficult to get rid of a bad style once acquired; and the Committee consequently attach great importance to the training whereby telegraphists acquire their style, and to the adoption of careful and systematic methods of instruction.

Style is a personal characteristic. A style that will suit one telegraphist may not suit another; and many good and rapid workers do not limit themselves to one style of sending, but vary their methods to suit different keys and to prevent monotony.

There should, therefore, be no one cast-iron system for everyone; and a stereotyped style of keying, if insisted upon indiscriminately and without special reference to the physical peculiarities of each individual learner, is likely to produce the very effect sought to be avoided, namely, instead of a free, loose, flowing, easy and natural style, fast yet deliberate, one that is cramped, rigid and unnatural and likely to prove irksome and tiring to the operator.

The Committee find that the arrangements for the instruction of learners in style are generally satisfactory at the larger offices, but that at many of the smaller offices they leave much to be desired; and they are of opinion that they should be systematized and improved.

The Committee's recommendations for the general training of learners will be found in paragraphs 56-64.

(e) *Too early responsibility.*

43. Telegraphists' cramp has been sometimes attributed to the employment of young telegraphists at busy circuits before they have gained enough skill and experience to undertake the responsibility without strain. Employment of young telegraphists on busy circuits.

The Postal Telegraph Clerks' Association have represented, in a memorial to the Postmaster-General which has been referred to this Committee, that the conditions of employment of young telegraphists in the Central Telegraph Office have within the last few years changed for the worse in that (1) telegraphists with less than five years' service are no longer employed half-time at minor circuits and in the practice group, but as soon as they are qualified they take duty in the busy provincial divisions at heavy commercial circuits; and that (2), whereas learners formerly left the school with little more than a rudimentary knowledge of their craft, and acquired manipulative efficiency later in a gradual and natural manner, they are now required to attain in a period of training limited to one year what is described as the exceedingly high speed of 24 words a minute on the Morse sounder instrument and to pass severe practical tests before a certificate of qualification is given. The Association add that under these conditions a young telegraphist is subjected to forcing of the most unremitting character from the very outset of his career, and that the excessive demand made on his resources is prejudicial to his physical and mental well-being and productive of nervous stress and arm trouble. Memorial from Postal Telegraph Clerks' Association.

44. This criticism raises two distinct and important questions, the training of Learners in telegraphy, and their employment during the period immediately following their training.

The Committee have made enquiry into the arrangements for the instruction of Learners in the Central Telegraph Office. Before 1901, Learners attended the School until they attained the minimum qualifications for appointment—ability to send 20 and receive 12 words a minute. The qualifying period was about three months. On appointment they were sent to the instrument rooms, where, for about eight months, they spent half their time in collecting and distributing telegrams and the other half in practising on spare instruments or sitting alongside telegraphists to watch their work and send as much as they were permitted. In 1901, the School was brought into a more accessible position in the main building of the Central Telegraph Office, but separate from the instrument rooms; and all the practising instruments Training of Learners in the Central Telegraph Office.

were removed from the instrument rooms to the school so that instruction and practice might be carried on in the same place.

Since then, Learners have had systematic training in the School until they are qualified to take charge of a circuit, or, as it is now expressed, are qualified to undertake instrument duty. This training takes on an average about 10 months. They are then set at a working circuit in the instrument room and receive careful supervision until they are able to work alone. After about two months, a Learner in the Central Telegraph Office is expected to be able to take charge of a moderately busy circuit. The total qualifying period is thus, as a rule, about 12 months. Some qualify in a much shorter time, and backward Learners are freely granted extensions of time, in some cases for five or six months beyond the year, if they show the least promise of qualifying. After qualification, Learners are ready for appointment to the establishment as vacancies occur.

In view of the facilities for training provided in the school, the Committee cannot regard the degree of proficiency which Learners are expected to reach in 12 months as being too high. No evidence has come before the Committee to show that Learners are "forced," as stated in the memorial referred to in paragraph 43, or unduly pressed to learn quickly.

Employment
of young
telegraphists
at heavy
circuits.

45. The Committee have obtained the opinion of experts in telegraph matters throughout the country on the employment of young telegraphists at heavy Morse circuits. There is general agreement that young telegraphists should be put at the lighter circuits at first and gradually work up to the heavier circuits as they gain skill and experience. They should not be allowed to overtax their powers, but they should not be kept back if their skill warrants their advance to more important work. Some young telegraphists acquire skill and confidence much more quickly than others, and the length of service to be reached before they can safely be entrusted with the charge of a busy circuit will vary in a corresponding degree. As stated in paragraph 35, returns have been obtained of the number of messages which 96 qualified Learners and young Telegraphists having an average service of 1 year and 8 months were able to send and receive in one hour, and of the manner in which these messages were sent and received. The conditions of the experiment have already been described. The average number of messages dealt with by the operators concerned was 43.4 with 5.5 repetitions and corrections; the sending was remarkably good, and the average number of errors negligible. So far as the evidence before the Committee shows, the rate of sending at busy Morse circuits in the Central Telegraph Office is not high; and even during the busier hours of the day (10 a.m. to 2 p.m.) it is the exception rather than the rule for 43 messages to be dealt with by one operator in an hour.

Difficulties
of telegraph
work.

The Committee recognize that the quantity of traffic dealt with is not the sole measure of a telegraphist's work.

More work can be done when the electrical conditions are good than when they are bad or variable. It is part of a telegraphist's work to adjust his apparatus; and this adjustment is more difficult at duplex circuits than at simplex circuits, and at quadruplex circuits than at either. Difficulties are also proportional to the length and condition of the line; and the introduction of repeaters adds to the complexity of the conditions. With duplex and quadruplex circuits, readjustment from time to time is necessary with changing weather conditions, disturbances due to working gangs, &c., &c. Underground cables are immune from some of these difficulties, but they introduce others peculiar to themselves. Experienced telegraphists are able to deal with most of these difficulties; but those of less experience sometimes find it necessary to appeal to their supervising officers.

There are also psychological difficulties to contend with. The responsibility of dealing with important public messages may cause anxiety and nervous strain to a young and inexperienced telegraphist; impatience or want of consideration on the part of the telegraphist at the other end of the line, a sudden rush of work, or any unexpected difficulty in working, may make him nervous and impair his confidence.

Taking all these things into consideration, the Committee are of opinion that a young telegraphist for the first two years after he has qualified for instrument duty should not be employed to take charge, as a regular duty, of heavy and difficult circuits; but they see no objection to the occasional employment of such an officer at such circuits while the telegraphist nominally in charge is at meals or otherwise absent for a short time, provided that the supervising officers consider that the work is not beyond his capacity.

The Committee consider that, after these two years' service, a telegraphist should, as a rule, be able to take charge of any Morse circuit not exceptionally difficult; but that for the next two years he should remain under careful supervision, particularly if he is of a highly strung or nervous disposition, and should be given immediate relief if he is observed to have any difficulty in working. (See paragraph 66 on Supervision).

After four years' instrument duty any telegraphist possessing normal health and skill should be equal to any duty to which he may be assigned.

The Committee's recommendations on standards of qualification and the training of Learners generally will be found in paragraphs 56-64.

(f) *Heavy Manual Work.*

46. It has been represented that cramp may be caused by heavy manual work outside the office, or by employment on postal work alternately with telegraph work. Heavy manual work.

The Committee see no reason to think that cramp may be caused in any such way. Manual work, if carried to excess, may possibly interfere with a telegraphist's efficiency, but otherwise it should be beneficial and tend to improve his general health.

Stamping and heavy postal duties might be harmful to a Learner and impede his progress, but the Committee understand that Learners are rarely employed on such duties. Telegraphists at "amalgamated" offices are employed regularly on both postal and telegraph work, and the incidence of cramp among them is less than half that amongst telegraphists at larger offices employed solely on telegraph work. So far as cramp is concerned, the Committee can find no objection to this arrangement. In fact, it is an advantage, in so far as it provides a variety of work which purely telegraphic work cannot give, and alleviates the monotony and tedium of which many telegraphists complain. Postal duties.

(g) *Morse Keys.*

47. Telegraphists' cramp has been said to be caused by the manipulation of Morse keys, particularly those types with hard contacts and a small amount of play in the signalling lever; and the Committee have been specifically asked to report how far the types of Morse key most generally in present use are responsible for nervous and muscular trouble. Morse keys.

Early observers did not differentiate between the cramp of workers with the Morse instrument and that of workers with other telegraph instruments; and some considered that cramp occurs only among Morse workers. It has already been shown, however (paragraph 11), that any instrument which calls for repeated fine movements of the same kind may involve its relative form of cramp; and the more restricted the movements are in range and character, and the more rapidly they are repeated, the greater is the liability to cramp.

The Morse key is manipulated with one hand, with a constant up and down movement which may have to be made from one to six times to form each letter or other character; and the range of movement is very small. In other telegraph instruments both hands are used; the movements are generally wider in range and more varied than those required for working the Morse key; and in many of them one movement is enough for each letter. On these grounds, therefore, the Committee consider that a telegraphist of nervous instability is more likely to contract cramp from working at the Morse key than at other telegraph instruments.

There are two main types of Morse key in general use, the "single current" type and the "double current" type. The former has hard contacts, and the signalling lever is usually so adjusted as to have very little play. The latter has spring contacts, and the lever is usually adjusted with greater play. Many experienced telegraphists consider that the hard contacts and small play of the lever in the single current key make this key more liable to cause cramp than the double current key, but others hold a different view. So far as the movements made in using the single current key are finer and sharper than those made in using the double current key, they might be expected to be more likely to upset a telegraphist's nervous stability, and to lead to failure of automatism and eventually to cramp; but in practice telegraphists use either key as required, and it is not possible to get statistics showing the relative prevalence of cramp amongst users of the two types of key. The difference between the movements made in using the two types is very small; conflicting views are held by telegraph experts; and no definite evidence can be obtained.

The Committee therefore are not prepared to express a definite opinion whether one kind of key is more likely to cause cramp than the other; but there is a large balance of opinion in favour of the use of double current keys on important circuits where the sending duty is heavy and continuous; and the features which distinguish these keys from single current keys have led the Committee to make the recommendations which will be found in paragraphs 59 and 70.

(h) *Inadequate Working Accommodation.*

Undue crowding.

48. Representations have been made to the Committee that inadequate table space and undue crowding of operators together have led telegraphists to adopt a strained position when sending, and have thus been a contributory cause of cramp. As a result of the enquiries made, the Committee are satisfied that any such conditions have been due to exceptional local circumstances. The standard space allowed for each type of instrument, as laid down in the Engineer-in-Chief's book of diagrams, is adequate in their opinion, and if adhered to should not give rise to any complaint of inadequacy of accommodation. Wherever the standard space has not been allowed, steps should be taken to provide it.

General Conclusions as to the Causes of Cramp.

General conclusions.

49. The general conclusions of the Committee as to the causes of telegraphists' cramp may be summarized as follows:—

Telegraphists' cramp is the result of a weakening or breakdown in the central controlling mechanism of the brain; the coördination of the muscles used in the act of telegraphy becomes impaired, automatism fails, and pain and spasm are produced.

Two factors must be present, one a nervous instability on the part of the telegraphist, and the other fatigue resulting from the repeated fine movements required for sending by hand on a telegraphic instrument. Thus the constitutional state of the telegraphist must be taken into consideration equally with the act of telegraphy as a cause of cramp; the first may be regarded as the predisposing cause and the second as the exciting cause of the condition. This instability may be aggravated by any cause which lowers the general physical condition, such as worry, anxiety or ill-health, and is more commonly found in persons of nervous temperament than in others; and inaptitude for telegraph work, undue strain on young workers, or a bad style of sending may all be contributory causes of fatigue and possible breakdown.

The manipulation of any telegraph instrument may involve its own relative form of cramp; but the Morse keys commonly in use are specially liable to cause cramp because the movements are all made with one hand, are repeated more rapidly, and are more restricted in range and character than those made in the manipulation of other telegraph instruments.

The Committee cannot find that the so-called "average system" has any bearing upon telegraphists' cramp. The amount of work required of a telegraphist is not excessive and should have no ill effects on a person of average health; and proper consideration is shown to the staff in arranging the conditions under which the work is done.

MEANS OF PREVENTION.

50. It follows from the foregoing conclusions about the causes of telegraphists' cramp that the means of prevention to be suggested will fall under two heads: (I.) the prevention of the appointment of persons predisposed to cramp; and (II.) the prevention of prolonged fatigue and nervous breakdown in appointed telegraphists.

I.—*Prevention of the Appointment of Persons predisposed to Cramp.*

51. The Committee have carefully considered the recruitment of telegraphists, and whether candidates likely to suffer from cramp can be excluded by means of the general and medical examinations which they have to undergo.

Present methods of recruitment.

At head offices and at some of the larger sub-offices the telegraph work is done mainly by established "Telegraphists" or "Sorting Clerks and Telegraphists." Unestablished "Assistants" may also be employed, either permanently, or temporarily as leave substitutes and to meet pressure of work. At other sub-offices the work is done by Sub-Postmasters and unestablished Assistants employed by them.

The established classes are recruited mainly through the class of "Learners," but Assistants and others already in the service who are qualified in telegraphy may be established without passing through this class. Established classes.

Learners are chosen by means of competitive examinations, which may be open to persons not in the service of the Post Office (with or without special nomination), or limited to Boy Messengers and others in the service. During the last five years about 12 per cent. of the successful male candidates have been Boy Messengers, but this proportion is increasing. Candidates must be within the undermentioned limits of age on the date of the examination:—

Male Learners at large provincial offices—competitions open to anyone without special nomination	14½–16
Male Learners in London—competitions open to anyone without special nomination, or limited to Boy Messengers, &c.	15–18
Male Learners at provincial offices—competitions limited to Boy Messengers, &c., or open to anyone with special nomination	15–18
Female Learners, all competitions	15–18

The subjects of examination are—

- (1) English composition (including handwriting and spelling);
- (2) Arithmetic (first four rules, simple and compound);
- (3) Geography.

Successful candidates have also to pass a medical examination.

Candidates are not required to have a knowledge of telegraphy, and those who are successful in the examinations are taught telegraphy by the Post Office. They remain "Learners" until they are qualified and there are vacancies on the establishment to which they can be appointed. After appointment to the establishment, the young telegraphist is required to serve a probation of 12 months before the appointment is confirmed. During this period rejections are made occasionally on grounds of health, conduct and efficiency.

Unestablished Assistants are engaged by the Postmasters or Sub-Postmasters who require their services. Unestablished Assistants.

Permanent full-time Assistants at head offices and at salaried sub-offices are eligible after five years' service for direct appointment to the establishment as Sorting Clerks and Telegraphists. They are recruited mainly from Assistants at scale-payment sub-offices and from qualified Boy Messengers; and they are required when first employed to be within the same limits of age as those in force for established officers, and to pass a medical examination. At head offices, and to a large extent at salaried sub-offices, these Assistants are being replaced by established officers.

Season Assistants are employed temporarily to meet pressure of work and as leave substitutes.

A limited number of Boy Messengers may be chosen for training in telegraphy with a view to employment as Season Assistants and as Assistants at salaried sub-offices; and at towns where female Season Assistants are regularly required, Postmasters may also train a limited number of females who wish for temporary employment.

Assistants at scale-payment sub-offices are the servants of the Sub-Postmasters who employ them; and the Postmaster-General is not directly responsible for their training or conditions of employment. These Assistants generally learn telegraphy, with such help as may be available, at the sub-offices where they are employed; but in special circumstances instruction may be given at any Post Office where arrangements can be made without inconvenience or expense.

52. It will be seen that the examination by which Learners are now chosen does not take aptitude for telegraph work into account. It has been shown in paragraph 25 that the earlier method of recruitment from Boy Messengers who had learnt telegraphy in their spare time admitted of discrimination between those who had shown aptitude and those who had not; and whereas this class formerly furnished the majority of telegraph recruits, the proportion of successful candidates proceeding from this source has latterly been as low as 12 per cent. Recruitment from Boy Messengers and Girl Probationers.

The Committee have carefully considered the advantages and disadvantages of a return to this method of recruitment. To limit the recruitment of male telegraphists mainly to Boy Messengers chosen for their aptitude in telegraphy would probably lead to an improvement in the general standard of operating skill, and to a reduction in the number of cases of cramp; and female telegraphists might be recruited in the same way from the class of Girl Probationers, which has recently been instituted to do indoor duties in place of Boy Messengers in accordance with the recommendation made in the first report of the Standing Committee on Boy Labour in the Post Office. On the other hand, as has been pointed out by

many responsible officers whose opinions have been sought, telegraph operating is not the sole duty of a Sorting Clerk and Telegraphist. Even at offices with a separate telegraph staff, where a large part of the work consists of operating, provision has also to be made for clerical and technical duties which call for better education and greater intelligence. At offices where postal and telegraph work is done by the same staff, postal work usually predominates. At many of these offices comparatively little time is given to telegraphy, and efficiency in postal work is of more importance than a high degree of telegraphic skill.

At both classes of office all the superintending officers and most Postmasters are appointed directly or indirectly from the ranks of Sorting Clerks and Telegraphists. They are rarely required to telegraph, and the qualities most necessary for them as superintendents—power of control and organizing ability—are not brought out or developed by operating work. When a telegraphist has reached the limit of his manipulative skill, which he may do in a few years, the continued exercise of his art has no educational value and does not tend to fit him for advancement to a higher position; and when he has been advanced, he ceases to operate. For these reasons it is strongly felt by the officers consulted that the standard of education should be kept as high as possible, even if this should involve the sacrifice of some telegraphic proficiency; and that Boy Messengers and Girl Probationers taken on when about 14 years old would not prove on the whole so suitable as older candidates recruited by open competition, who have had the advantage of one or two additional years at school.

The whole question of the employment of Boy Messengers and Girl Probationers is now being considered by the Standing Committee on Boy Labour. That Committee is taking steps to provide suitable secondary education for all Boy Messengers; and if as a result these Messengers no longer compare unfavourably as regards education with Learners recruited by open competition, the main objection to a return to the earlier method of recruitment would, in the opinion of this Committee, be met.

Whether it is practicable to confine recruitment to Boy Messengers and Girl Probationers must be determined by general considerations which lie outside the province of this Committee. They favour an increase in recruitment from this source, subject to the conditions above mentioned; and recommend that, so far as telegraph recruits are drawn from this class, the boys and girls be chosen primarily for their aptitude in telegraph work and not merely for their success in an examination of a general character. They therefore suggest the provision of some telegraphic instruction as part of the secondary education to be given to these boys and girls. Those who show aptitude and liking for the work could soon be picked out, and their training continued until they are qualified. They need not pass through the class of Learners; but they should be appointed direct as Sorting Clerks and Telegraphists after a qualifying examination, which should be competitive if there are more candidates than situations.

Limits of age for Learnerships.

53. So far as it is found desirable or necessary to continue recruitment through the class of Learners by means of competitive examination open to persons not in the service, the Committee are of opinion, for the reasons given in paragraph 26, that the maximum limit of age—18 years—for candidates at most offices is too high to give the best results; and they recommend that the limits should be 14-16 at all offices, excepting only at those where postal exigencies make an extension of age necessary, and that at such offices the limit should be 17 years.

Subjects of examination.

The Committee have considered whether fresh subjects could be introduced into the examination, or greater prominence given to some existing subjects, so that the examination might afford a better criterion of aptitude for telegraph work than it now does. Typing has been suggested as a useful additional subject; but the proposal has been objected to by many practical telegraphists on the ground that it would offer no real guide for this particular purpose. The Committee admit that this objection in large measure is a valid one, though they regard proficiency in typing as a useful general indication of quickness, a supple wrist, and a light dexterous touch; but having considered the extent to which the use of typewriters and instruments with typewriter keyboards is growing in the Telegraph Service, and the probable usefulness of the art to telegraphists generally in the future, they do not hesitate to recommend typing as a suitable subject for addition to the examination.

Hand-writing.

Inability to write well and quickly has been generally observed as a characteristic of cramp subjects. It would not be safe to condemn an indifferent writer at the examination stage as a probable cramp subject. But the Committee are informed that special attention is now given to handwriting in this examination, and they entirely concur in regarding this as a subject of the first importance.

54. The Committee have made enquiries whether sufferers from cramp have been observed to have any characteristics in common which would enable a Medical Officer to say at the initial examination whether a candidate is likely to break down with cramp or not. The characteristic most generally noticed in cramp subjects is nervousness of temperament; and the Committee are of opinion that persons of nervous disposition should not be appointed as telegraphists. Medical examination.

The Committee recognize that it is very difficult for a Medical Officer to say at the early age at which most candidates come up for examination how they will develop; but they recommend that Medical Officers be instructed to pay particular attention to the nervous condition of candidates for telegraph appointments and to reject those who show signs suggesting permanent nervous weakness.

In the medical examination attention should be given to the family record of the candidate: the presence of a family history of insanity, hysteria, or epilepsy should be regarded as an indication that the inherited nervous constitution of the candidate is unlikely to withstand the strain of constant telegraph work.

Other characteristics which have been thought to indicate inaptitude are heavy or clumsy hands, stiff wrists, and an absence of a sense of rhythm; but the Committee do not consider these definite enough to warrant rejection on such grounds alone. Want of aptitude soon shows itself in a practical form during training, and a trustworthy opinion cannot generally be formed without an actual trial on the work.

The rejection of left-handed persons has been suggested; but the Committee do not consider left-handedness alone to be a sufficient ground for rejection. Right-handed persons usually have little difficulty in learning to send with the left hand, and there is no reason why a left-handed person should have greater difficulty in learning to send with the right hand.

The Committee recommend that the form for the medical examiner's report be revised in order to embody these views, and that the following footnote be added to the question* asking whether there are any circumstances which tend to disqualify the candidate from performing efficiently and regularly the duties of a telegraphist:—
“ In the case of candidates for telegraph appointments, the Medical Officer should pay special attention to the nervous disposition of the candidate, and the occurrence of insanity, hysteria, or epilepsy in the family. The presence of stiff wrists and heavy clumsy hands, and inability to write easily, should also be considered.”

55. As a general rule, however, aptitude for telegraphy can best be determined by trial at the work itself; and the Committee are of opinion that full advantage should be taken of the periods of learning and probation to exclude unsuitable persons. The attention of candidates should be specially directed to the regulation which provides that a Learner's services may be dispensed with at any time if he does not display sufficient aptitude for the duties; and this regulation should be strictly enforced. Inaptitude shown during learning and probation.

Where rejection is necessary it should take place at the earliest possible moment. The longer an inapt Learner is retained, the greater difficulty is he likely to have in finding other employment; and the Committee strongly deprecate the mistaken kindness of some supervising officers who have failed to bring defects under notice in the hope that the Learner will eventually qualify. A telegraphic expert should generally be able to say, after a pupil has been under training for three months, whether he is likely to make a good telegraphist or not; and the Committee recommend that a report on every Learner should be made at this stage with a view to his rejection if he is wanting in aptitude. In doubtful cases further examinations at later stages should be held at the discretion of the authorities. The Committee regard this examination of Learners as an important and responsible duty, and consider that it should be in the hands of qualified and experienced officers who should specialize on the work. The officers recommended in paragraph 64 to supervise generally the training of Learners might perhaps be conveniently entrusted with this duty. Early rejection recommended.

Attention should also be paid to the Learner's aptitude throughout the whole periods of training and probation; and he should not be appointed to the establishment if his sending is defective, or if there is any other reason for thinking that he will not make a good telegraphist.

The Committee do not think that a Learner who is found to be inapt within a few months of his entry into the service can be regarded as having any claim to Appointment of inapt Learners to other situations.

* Question 12 in the report on male candidates, 15 in the report on female candidates.

special consideration; but they express the hope that, when a Learner or Probationer who has already spent some years in the service of the Post Office as a messenger or in some other capacity is rejected for inaptitude, opportunity may be given to him by the Postmaster-General to enter some other branch of the service.

II.—Prevention of Nervous Breakdown and prolonged Fatigue in appointed Telegraphists.

(a) Training of Learners.

Importance of and object of training.

• 56. It has been stated in paragraph 42 that a bad style of sending may cause great fatigue and hasten the breakdown which culminates in cramp; and that the Committee attach great importance to careful and systematic training in order to develop the method of sending most suited to the individuality of each pupil. One style of sending will not suit all telegraphists; but there are features which all good styles have in common. The hand and forearm should be approximately level and in a line with the key, the signals should be sent with a free movement of the wrist, the key should not be pinched or gripped, and there should be no rigidity or constraint. The aim of training should be to see that the pupil, while retaining these essential features, acquires the style best suited to himself, enabling him to send firmly and freely, with crispness and clearness, and with good rhythmical formation of the signals.

The Committee recommend that the printed card of instructions for sending should be revised as shown in Appendix No. 5, so as to embody these guiding principles.

Present arrangements for training at large offices :

57. The machinery of training at present existing varies widely at different offices. At the Central Telegraph Office and a few large provincial offices regular schools are provided, fully equipped for the training of a large number of Learners in the manipulation of every kind of telegraph instrument in general use in the Post Office. One or more officers give their whole time to instruction. Sometimes they remain permanently on the duty; sometimes they are changed at more or less frequent intervals; sometimes the duty is taken in rotation by several officers.

at intermediate offices :

There are next nearly 100 offices where several Learners are employed partly on ordinary Post Office work. Here practising apparatus is, as a rule, permanently provided, and may consist of a mechanical sounder, or a short-circuited Morse sounder, or occasionally a Morse printer if this has been specially asked for. An officer may be set apart regularly to give instruction for part of his time, or instruction may be given at such times as an officer can be spared.

at small offices.

There is, finally, the mass of smaller offices throughout the country where frequently there are no Learners to be taught; and, when there are Learners, no special arrangements are made for teaching them. As a rule, Learners are not allocated with any special view to the teaching facilities: assistance is given if there happens to be a qualified officer who can be spared; but the staff have often little time for teaching; and in such cases the Learners have to pick up telegraphy as best they can.

At all these offices, in addition to authorized "Learners," Boy Messengers and other persons may be taught telegraphy with a view to their employment as Assistants, as shown in paragraph 51; and, so far as the Post Office undertakes the training of Assistants, the recommendations in the following paragraphs apply to them equally with "Learners."

No uniformity in instruction.

58. There is thus, at present, no uniformity in telegraphic instruction, either in conditions, methods of teaching, or apparatus. The Committee recognize that differences between one district and another in trade, population, and other determining factors preclude anything like a single complete system. They are, however, convinced that a much nearer approach to such a system is feasible and would be a gain to the service.

Teaching centres.

The Committee are of opinion that no learners should be employed at any office where correct instruction by a competent officer on proper apparatus cannot be given. These conditions, they believe, can be observed at most of the smaller offices. Failing this, the larger offices should be made use of as teaching centres for all smaller offices within a convenient radius. They have considered whether all learners could conveniently be trained at teaching centres. They find, however, that this course is not practicable for reasons of distance and expense; but the general development of such a system, and an increase in the number of offices provided with permanent practising apparatus, is to be encouraged, and, as far as possible, two or more pupils should be placed together under training at such centres.

59. Subject to these general conditions, the Committee offer the following recommendations for adoption at all offices where learners are regularly under instruction.

The instructor should be an expert telegraphist, but expert in style rather than in speed. Example has a great influence in forming a learner's style, and the instructor should be an operator whom the learner can imitate as well as listen to. The duty should not be taken in rotation by several officers; and the same officer should remain on the duty in ordinary course for not less than four years, taking it as part of his regular daily work in offices where it is not enough to occupy his whole time. Telegraph instructors.

The selection of properly qualified instructors and their transference or removal when necessary should be in the control of the Surveyor. The amount of time to be devoted to the instruction of each learner must be determined to a large extent by local conditions; but the Committee suggest as a general guide to practice that each should receive at least one hour's instruction daily (preferably in two or three instalments) during the first month, and half an hour's instruction daily during the second and third months.

The Committee recommend that practising apparatus should be permanently fixed, either in a separate room or in a separate part of the instrument room, at all offices where there are always pupils under instruction. Practising apparatus.

They consider that the mechanical sounder is of little value to a pupil learning telegraphy. In common with the short circuited Morse sounder, it has the disadvantage of giving a beginner no idea whether or not he is forming his letters properly; and correct formation and spacing cannot be acquired on these instruments without perpetual supervision. Moreover, as the mechanical sounder is a dummy instrument, the learner does not take so much interest in practising on it as on a real telegraph instrument. Mechanical sounders and short-circuited Morse sounders.

The Committee, therefore, recommend that the use of this instrument should be discontinued in telegraph schools, and that it should be restricted to cases where a learner who has acquired the elements of a correct style of sending has opportunities of supplementing his training by practice with a competent colleague outside the office.

The Committee consider that the use of a Morse printer is essential in the early stages of learning, as the printed slip enables a pupil to see faults of spacing and formation which his untrained ear would be unable to detect; and so far as this is concerned, a printer can give almost as much instruction as a personal instructor. Morse printers recommended.

The practising set should accordingly take the form of a "two-station circuit" made up of a Morse sounder and key at one end and a Morse printer and key at the other end; and, if the apparatus is joined up as a duplex circuit, four pupils can practise at the same time. The pupils should, as far as possible, practise together, sending and receiving in turn, and with the sending and receiving instruments placed as far apart as possible. Short-circuited instruments may lead to a careless way of sending, and there is more interest in sending to another person some distance off.

The Committee recommend for training learners the general use of double current keys with ample play, on the ground that they tend to develop free wrist action. Single current keys with hard contacts are apt, if too finely adjusted, to encourage finger action at the expense of wrist play; they are hard to the touch, and give a fictitious feeling of speed which may lead to light sending and the missing of dots. Where, however, several keys have to be provided, both kinds should be supplied. Double current keys preferable to single current keys.

60. In the smaller offices where instruction is intermittent, practising apparatus—usually a mechanical sounder—is now supplied on loan as required. The Committee recommend that a Morse printer should be supplied for practice wherever a pupil is under training in telegraphy. This should be used until letters can be signalled correctly. When this stage is reached a Morse sounder may be substituted; but the occasional use of the printer to check formation and spacing is desirable; and generally the practising conditions should be arranged, as far as possible, on the lines suggested in the previous paragraph. Each Surveyor should have at his disposal the apparatus required for occasional use in his district, to send wherever from time to time it may be wanted. Apparatus for smaller offices.

A learner at a small office should be allowed to practise with a learner at another office on the working circuits when they are not in use for traffic.

- Method of training.** 61. The learner must first get a thorough knowledge of the Morse code ; and it is recommended that he should be required to write in this code and to practise the reading of Morse slip. An early symptom of cramp is a difficulty in sending some specified letter or number ; and it is important that a learner should know thoroughly the formation of every letter and figure before he begins to send. He should next learn on a Morse printer to send dots and dashes, at first separately, then combined with relative spacing into letters and words. The instructor should see that the learner is acquiring a good style ; but when once he is on the right road, constant supervision is not necessary, as the learner can see for himself from the printed slip whether he is forming the letters properly or not. He should not, however, be always looking at the slip : too frequent reference to the printer in an effort to get absolute mathematical accuracy of formation is likely to hinder him from gaining confidence. The production of theoretically perfect signals, such as those sent by a Wheatstone transmitter, should not be aimed at. In hand signalling, the dots are generally made a little longer relatively to the dashes than in automatic Wheatstone signalling ; and too close imitation of the latter may lead to a sharp jerky style which is difficult to read by sound. Good spacing and a regular formation of dots and dashes are essential ; but the relative length of dot and dash is comparatively unimportant so long as the difference is sufficiently marked and regular.
- Learners should not try to send fast.** 62. Learners should not be pressed to send fast ; and "rushing" should not be allowed. Just as in the teaching of the piano, speed is the last thing to be aimed at : given an easy style and good formation, it will follow of itself by degrees. Efforts to acquire speed while style is immature have laid the foundation of many cases of cramp ; and the Committee disapprove of the practice sometimes followed in telegraph schools of testing frequently a pupil's rate of sending, and warning him to improve in speed on the previous test if no advance is shown.
- Standards of qualification. Message test better than word test.** 63. In order to encourage good steady working at a moderate speed rather than indifferent working at a higher speed, the Committee recommend that the tests of the number of words sent and received per minute, which Learners at provincial offices now have to pass before receiving the first and second increases of pay, should be discontinued, and that they should be required instead, for the first increase of pay, to be able to send and receive in about equal proportions 25 ordinary public messages in an hour with no uncorrected errors and not more than five repetitions and corrections, and, for the second increase of pay, to be able to send and receive in about equal proportions 35 ordinary public messages in an hour with no uncorrected errors and not more than five repetitions and corrections. The tests should be made in the school at practising circuits, with copies of real messages averaging 14 words each excluding the preamble. Each test should extend over one hour ; and for the receiving test a sender of accuracy and experience should be provided.
- Supervision of training.** 64. The Committee recommend that a specialist in telegraphy should be delegated by each Surveyor to supervise telegraph training at "al amalgamated" offices in the Surveyor's district, and to grant the Learners' certificates of qualification for increases of pay and for appointment. It may be found convenient that he should be the officer to report on the aptitude of Learners, as recommended in paragraph 55. At "divided" offices independent supervision should not be necessary.
- Ambidexterity.** 65. The Committee consider that it is an advantage to a telegraphist, and likely to prevent the onset of cramp, if he can send with either hand, so that if one hand is tired he can use the other.
- A telegraphist should not wait to acquire ambidexterity until he has difficulty in sending ; it may then be too late to benefit by it. The Committee do not recommend that Learners should be taught to send with either hand ; this would prolong the period of training, and it is desirable that they should become expert in the use of one hand before learning to use the other ; but after they are expert in sending with one hand they should be encouraged to become ambidextrous.
- (b) *Organization.*
- Supervision.** 66. The Committee are of opinion that it should be clearly understood to be part of the regular duty of supervising officers, not only to get the work off, but to see that the telegraphists under their control are working at a proper speed, that is, neither

quicker nor slower than is right, and in an approved style. They should report at once if any difficulty is observed; and they should be required to pay special attention to the working of young telegraphists and to take care that they are not put to work beyond their capacity. A young telegraphist is liable to occasional loss of confidence which may result in nervous strain and breakdown; and supervising officers should give immediate relief if a young officer is observed to have any difficulty in working. The Committee recommend that specific instructions be issued to supervising officers to the above effect.

67. In paragraph 45, the Committee have already recommended that a young telegraphist should not be employed to take charge as a regular duty of heavy and difficult circuits for the first two years after he has qualified for instrument duty, and that for the next two years he may be employed, subject to careful supervision, to take charge of any Morse circuit not exceptionally difficult. After four years' instrument duty, any telegraphist possessing normal health and skill should be equal to any duty to which he may be assigned.

Allocation of Morse duties.

The Committee are of opinion that the practice of assigning the heavier Morse duties to the senior men, while right in the main, has in some cases been carried too far; and they recommend that all telegraphists after four years' instrument duty should be given a share of the heavier Morse duties, and that the instruction* conveyed in Circular to Surveyors No. 31 of 1909 should be extended in the direction of giving the senior men a share of the lighter Morse duties.

The Committee are not able to recommend any further extension of rotation upon writing duties or other non-manipulative duties which call for special skill or experience in their performance.

Rotation on writing and other special duties.

The Committee can find no direct connexion between the amount of continuous sending or receiving and cramp; but they consider that long periods of continuous duty of either kind are likely to be injurious and should be discouraged. They therefore recommend that continuous working in one direction should be limited by regulation to two hours in all cases, except where administrative difficulties forbid. They understand that at duplex circuits such a limit is often arranged by mutual consent in many offices.

Limitation of continuous working in one direction.

(c) *Instruments and Apparatus.*

68. The Committee have given careful consideration to the various suggestions which have been made to them for the improvement of the Morse keys used by the Post Office.

Morse keys.

It has been shown in paragraph 47 that these keys are of two general types, the "single current" type which has hard metal contacts, and the "double current" type which has spring contacts. A full statement of the various forms of telegraphic keys at present in use will be found in Appendix No. 6.

Criticisms of these keys have related mainly to the size and shape of the finger knob, the nature of the contacts (hard or soft), the amount of play in the signalling levers, the degree of force required to operate the keys, their height in relation to the operator's arm, and their positions on the instrument tables.

Criticisms of Morse keys.

69. It was represented by one witness—Mr. Newlands—that the standard pattern of finger knob is too small, and that the tendency of some telegraphists to "grip" the key when sending would be reduced by making the knobs slightly larger and more rounded on their upper surface. The Postal Telegraph Clerks' Association, while approving the present size, recommended a rounded top. A number of knobs varying in size and shape were therefore obtained and subjected to a practical trial in the Central Telegraph Office and at Glasgow. The result showed that the present standard knobs are better liked by telegraphists than any of the variations; and the Committee therefore do not recommend any change in this respect. The replacement of the knob by a short octagonal bar was also suggested, but this was found to be a failure in practice.

Finger knobs.

70. It was represented by the witnesses from the Postal Telegraph Clerks' Association that the hard metal contacts fitted on single current keys are less popular among telegraphists than the spring contacts with which double current keys are

Contacts.

* "At the larger offices, the duties should be arranged on a system of rotation so as to give as much relief from Morse manipulation as the work will admit; this is specially desirable in the case of above-bar officers who must necessarily be employed on the heavier and more important Morse circuits."

provided, and that the former type of key was more conducive to cramp. The Association had previously obtained expressions of opinion from the operating staff at 24 offices, and it was found that, although opinion was much divided on the point, the balance was in favour of the spring contact double current keys in the proportion of about two to one. The Medical Sub-Committee, in their examination of the "F" Division of the Central Telegraph Office, found that of those telegraphists whose choice was recorded 78 per cent. chose the spring contact key for their use in the trial.

Several single current keys were fitted with spring contacts as an attempt partially to reproduce the conditions of double current keys, and were tried at the Central Telegraph Office, Bristol, Edinburgh, Liverpool, and Belfast. The reports received were almost unanimously against the keys so fitted; and this method of compromise must therefore be pronounced a failure.

It will be seen from the statement in Appendix No. 6 that the double current type of Morse key is much more expensive than the single current type, both as regards first cost and annual maintenance charges.

The Committee see no reason to recommend the abolition of the single current type of key; but they are of opinion that on important circuits, where the sending duty is heavy and continuous, the double current key with its softer contacts is to be preferred, and they recommend an extension of its use on such circuits. They also recommend the systematic use of this key, in preference to the single current key, in the training of learners. (See paragraph 59.)

Adjustment
of keys.

71. The adjustment of single current keys can readily be carried out by the operators so as to meet their individual preferences in the matter of spring tension and the amount of play of the levers. The corresponding adjustments of double current keys are, however, fixed in the workshop and cannot be altered by the operators.

In order to determine the most suitable adjustment for double current keys, 18 keys were obtained in which the play of the levers and the tension of the antagonistic springs had been regulated to different degrees. Twenty-four selected experienced telegraphists, as well as the representatives of the Postal Telegraph Clerks' Association and other practical officials, were asked to indicate the keys which they considered to represent the best adjustment; and the consensus of opinion thus obtained showed that the most favourable operating conditions are secured with a lever play of $\frac{3}{4}$ ths of an inch, and with a spring tension which will just allow the key to be actuated when a weight of 6 ounces is placed on the knob. The Committee recommend that these particulars be uniformly embodied in the specifications for the construction of double current keys. They also recommend that keys already in use be adjusted to the same standard. Since, as already mentioned, single current keys can readily be adjusted in both respects by the telegraphists themselves, it is unnecessary to subject them to any general readjustment.

The representatives of the Postal Telegraph Clerks' Association suggested that all keys, before they are sent into store for issue, should be examined and tested by officers who have a practical knowledge of telegraphy, in order to ensure that the lever and springs are perfectly adjusted and that the key is properly responsive to the touch. With this view the Committee are entirely in accord, and are of opinion that the officers of the Engineering Department who test keys should have a practical knowledge of telegraphy.

Height of
keys above
table.

72. One of the witnesses representing the Postal Telegraph Clerks' Association suggested that the keys should be slightly sunk into the instrument tables. The Committee think that, having regard to the considerable re-arrangements in the positions of the apparatus which are in practice required from time to time, it would be inadvisable to do this. They are of opinion that the necessary correlation between the height of the operator and the height of the key can best be secured by the careful choice of chairs of suitable height in each case. (See paragraph 83.)

Position of
keys on
instrument
table.

73. The question of the position of keys on the instrument table is largely bound up with that of whether or not telegraphists require any support for the forearm when sending. In this country the view that such support is needed has never been held; and it is usual to fit the keys fairly close to the front of the table. In the United States, on the other hand, the universal practice of telegraphists is to allow the forearm to rest on the table. The keys themselves are much less in height than those of the British Post Office, and they are fitted much further back on the tables. After hearing many opinions on this subject and considering it carefully, the Committee conclude that the practice of the British Post Office is less conducive to the development of cramp and is in every way preferable to the practice in the United States.

Some suggestions for the provision of arm rests for attachment to instrument tables were referred to the Committee and have been considered. Arm rests.

The opinion of 514 practical telegraphists throughout the country has been sought on the question of such rests, and it is almost unanimous that complete freedom of the wrist is essential to proper manipulation and that to rest the arm causes constraint and is likely to lead to cramp. This opinion is in accord with the views formed by the Committee on the etiology of the disease; and they therefore cannot recommend the adoption of any such appliance.

74. The substitution for the Morse key of some other key or sending device less liable to lead to cramp has been considered. Substitutes for the Morse key.

From the early days of the telegraph, efforts have been made from time to time to devise a transmitter with a keyboard of typewriter form in which one depression of a lettered key would cause the Morse symbols corresponding to that letter to be signalled over the circuit. The general idea or principle is good; and the general use of an instrument of this kind would go far to prevent cramp; but mechanical difficulties have hitherto prevented the production of an entirely satisfactory instrument. Keyboard transmitters.

75. In America, semi-automatic Morse keys are used to lessen the strain of sending by many telegraphists who have difficulty in using the ordinary Morse key. Various forms are in use, and are known as the "Vibroplex," "Autodot," "Mecograph," &c. The essential element is a weighted spring which can be made to vibrate by the lateral movement of a finger lever in one direction, making and breaking an electrical contact with each vibration until the lever is released. The "dots" of the Morse alphabet are thus set out automatically. The "dashes" are sent by a movement of the lever in the reverse direction, which causes a continuous current to be sent as long as the lever is held over. Thus, by manipulation of the key, the operator controls the number of dots and sends the dashes directly. Fewer separate movements of the hand are required than in the manipulation of an ordinary Morse key. The American telegraph code is composed of more dots than the European code; and semi-automatic keys are proportionately more valuable there than here. Semi-automatic keys.

76. The experience of the American Telegraph Companies with these semi-automatic keys is described in Mr. Purves' report—Appendix No. 4. The keys are found to be satisfactory if properly adjusted so that the dots are not sent unduly fast in relation to the dashes; but bad adjustment causes much trouble; and so much difficulty is found in getting telegraphists to pay proper attention to this matter that the Postal Telegraph Company of the United States of America are considering whether the use of these keys should not be stopped. Neither of the American Telegraph Companies has a record of any telegraphist having acquired cramp from the use of these keys; and many American telegraphists who were incapacitated by cramp from using ordinary Morse keys are said to have been able to continue satisfactorily at manipulative work by using semi-automatic keys. Semi-automatic keys in America and Australia.

After taking evidence about these "Vibroplex" keys, a Royal Commission in Australia which recently reported on the Postal Services in the Commonwealth did not recommend the compulsory use of such keys by all telegraphists, but considered that offices should be sufficiently equipped with them to provide telegraphists with relief before they actually break down with cramp.

77. Trials have been made of "Vibroplex" and "Autodot" keys in this country during the last two years. Use in this country.

The keys are made for the "closed-circuit" system of telegraphy in general use in America; and the addition of a transmitting relay is necessary to adapt them to the ordinary form of "open-circuit" system used in this country. Further, in order to control the number of "dots" sent by the automatic vibrator, the operator must hear on his own sounder the signals he is sending; but the system of telegraph working in use in this country, unlike that in use in America, does not admit of this in the ordinary course; and an additional sounder (which may be combined with the transmitting relay) must be provided, unless, as is sometimes practicable, the sounder provided for reception can be joined up to respond to signals sent as well as to those received.

Again, the American system admits of the easy connexion and disconnexion of a semi-automatic key as an auxiliary to an ordinary key; and a telegraphist who uses a semi-automatic key can readily move from one circuit to another, taking

his key with him. The English keys and system of connexions do not admit of the temporary attachment of auxiliary keys ; special arrangements must be made to connect them ; and they can be used only at the circuits to which they are thus specially connected. It will thus be seen that the keys are not so suitable for the conditions of telegraph working here as in America.

Some telegraphists suffering from cramp, and others who are not affected, have been taught to use these keys and employed at circuits fitted with them. The telegraphists with cramp have found them easier to work and to cause less strain than ordinary Morse keys ; but the keys have not been in use long enough to judge how far these favourable reports may be due to novelty, and it is doubtful whether continued use might not lead to a different opinion. The telegraphists who have no difficulty in using ordinary keys generally prefer them to the semi-automatic kind.

The sending is often erratic and difficult to read ; and the disproportionately high speed at which the dots are apt to be sent increases the strain on the receiver. Some complaint has been made of difficulty in adjusting the keys to admit of the "dots" and "dashes" being signalled at the same relative speed ; and some telegraphists who have used the key prefer to send the "dots" manually in the same way as the "dashes" instead of using the automatic part of the key. When so used they are much inferior to the ordinary Morse keys.

The Committee do not consider that there has yet been sufficient experience of these keys in this country for a definite opinion to be formed of their value. The reports from America would seem to show that, under the conditions of working which prevail there, semi-automatic keys afford real relief to telegraphists suffering from cramp ; and the Committee recommend that the trials should be continued, and that an extension of the use of these keys should depend on the results of their further working.

20th Century
key.

73. Another modified type of Morse key of American origin, known as the "20th Century" key, has also been obtained. This form of key has a drop handle which can be adjusted to different angles in order to vary the strain on the muscles used in sending. Even in America these keys have not yet become generally known. Two of them were given a practical trial in the Bristol office ; and reports were obtained from several telegraphists, including some affected with pronounced cramp, some suffering from minor affections (rheumatism of shoulder and weak wrist) and others perfectly free from cramp symptoms. The sufferers from cramp reported that the manipulation of the special keys did not afford any relief as compared with that of ordinary Morse keys ; but the opinion of the unaffected operators was that the former keys were the easier to manipulate, that the physical strain of sending was more distributed, and that the variety of positions in which the handle can be set was a factor which afforded relief.

The opinion of the instructor of telegraphy in Bristol was, on the whole, against the keys ; and he reported that some of the learners complained of arm-ache after using them.

It was found that the speed of sending was definitely lower than with the ordinary Morse key, and it is probable that efforts to obtain the same speed on the special keys would be attended with considerable strain. In all the circumstances the Committee have concluded that the "20th Century" key does not promise to provide a satisfactory relief instrument for telegraphists who show signs of incipient cramp.

Alternative
systems of
telegraphy.

79. The Committee have given careful consideration to the policy of a replacement of the Morse sounder system wholly or in part by other telegraph systems which would be less likely to lead to cramp.

The chief systems other than the Morse are : —

- (1) Machine telegraph systems, where there is no hand-keying and signals perforated or punched on slip are sent by an automatic transmitter. The signals may be punched singly by hand-punches or "sticks," or in letters on a keyboard perforator ;
- (2) Systems in which the sending is done on a keyboard of "piano" type ;
- (3) "Single Needle," "Bright's Bell," and "Double Plate Sounder" systems, in which the sending is done on a commutator or "double tapper," when both hands are used ;
- (4) Wheatstone's A.B.C. communicator, where the right hand is used to drive a generator and the left hand to manipulate a circular range of keys corresponding to the letters of the alphabet ;
- (5) Telephones.

(1) *Machine Telegraph Systems.*—The oldest and most important of these systems is the “Wheatstone Automatic.” The perforated slip is commonly prepared with a “perforator” worked by hand by means of “punching sticks”; but keyboard perforators, where the slip is prepared by the manipulation of letter keys on a keyboard like that of a typewriter, have lately been introduced, and their use promises to endure. Machine telegraphs.

The “Wheatstone Automatic” is a high speed system worked at a rate of from 50 to 250 words a minute, though capable of more. It is in general use for press work, and is now being used continuously for ordinary commercial work at busy circuits. The Committee understand that its use in this manner shows great promise, and that it is likely to be widely extended.

Other machine telegraph systems are experimental. Many show promise, but they have not advanced as far as the Wheatstone. The preparation of perforated slip with a keyboard perforator is common to all these systems.

(2) *Systems with “Piano” Keyboards.*—Among these are the “Hughes” and the “Baudot,” which are used principally on circuits between England and the Continent. The Hughes has long been in use on a few inland circuits: the Baudot is now being tried between London and Birmingham and its extended use is under consideration. Hughes and Baudot systems.

(3) *Single Needle, Bright’s Bell, and Double Plate Sounder Systems.*—The method of sending with “double tapper” is the same in all these systems. All the signals are of equal length; but the “dots” of the Morse alphabet are struck with the left hand, and the “dashes” with the right hand. These systems were much used in the early days of the telegraph service before and after the transfer. Comparatively few now survive in the Post Office service, but many are still used by railway companies. The manipulation of the “double tapper” can be learnt more easily than that of the Morse key, and from this standpoint the systems are well adapted for use on minor circuits by Sub-Postmasters and their Assistants who have little opportunity of learning how to use the Morse key and of keeping up their skill; but these systems are more costly than the Morse system both to install and to maintain; and from an engineering point of view the Morse system is to be preferred. Single Needle, Bright’s Bell, and Double Plate Sounder systems.

(4) *Wheatstone’s A.B.C. Communicator.*—This system is exceedingly simple to work, and little or no training is required on the part of the operators; but it is slow, and the rate of working seldom exceeds five or six words a minute. The system is used only on private wires and village circuits and is steadily being superseded. Its maintenance is costly. A.B.C. instruments.

(5) *The Telephone.*—The use of the telephone for the transmission of telegrams has generally been limited to circuits with little traffic; but there is reason to believe that with expert operators a telephone circuit may carry a heavy load. Moreover, telegrams are now being delivered to the public and received from them by telephone; and generally there would seem to be wide possibilities of an extended use of the telephone in the telegraph service. Its use requires little expert training. Telephones.

80. It would thus appear that while systems such as the “Wheatstone Automatic” and the “Baudot” may replace the Morse sounder system at circuits where the traffic is heavy and continuous, the telephone may be used at all circuits where the traffic is light and intermittent. The Morse system would thus be limited to circuits intermediate in character; and even upon these the intrusion of the telephone is possible. Moreover, it may also be found advantageous to concentrate traffic more and more on main trunk circuits worked with fast automatic systems between zone centres from which telegrams would be distributed to their destinations by telephone. Eventually the Morse and other manual systems of telegraphy might drop out of use; and the work of a telegraphist would then consist in perforating slip with a keyboard perforator, typing messages for delivery, and sending and receiving messages by telephone. Future development of telegraphy.

The province of a telegraphist proper—that is, of a keying telegraphist, the telegraphist who is liable to suffer from telegraphists’ cramp—is thus already being invaded,—

- (a) as regards the busier circuits, by automatic systems where the work is generally of the same character as a typist’s; and
- (b) as regards the minor circuits, by the telephone, where skill less specialized than the telegraphist’s is required.

The main body also of the circuits are seriously threatened by the telephone.

The following statement shows the degree to which Morse working has declined and non-Morse working has developed in the Central Telegraph Office since 1909 :—

STATEMENT showing the relative use of the HUGHES, BAUDOT, WHEATSTONE, and MORSE TELEGRAPH SYSTEMS for Commercial Work in the CENTRAL TELEGRAPH OFFICE in 1909 and 1911.

Telegraph System.	6th May 1909.		12th May 1911.		Increase or Decrease in the Percentage.
	Number of Messages dealt with.	Percentage of Total for the Day.	Number of Messages dealt with.	Percentage of Total for the Day.	
Hughes - - -	23,563	11	28,635	12	+ 1
Baudot - - -	2,985	1	7,970	3	+ 2
Wheatstone - - -	2,251	1	18,511	8	+ 7
Morse - - -	195,004	87	188,171	77	- 10
Total - - -	223,803	—	243,287	—	—

The normal development of the art of telegraphy following new inventions is thus tending to replace skilled forms of manual work with forms of machine work calling for less specialized skill on the part of the operator. The Committee regard this as one of the governing factors in the problem before them. The reduction of the amount of Morse sounder working is taking place precisely where it is likely to have the greatest effect in the prevention of cramp, that is, in those circuits where the work is heaviest, and also in those where it oscillates between periods of activity and periods of waiting; and, so far as the replacement of the Morse system of telegraphy by other systems is concerned, the Committee are satisfied that each new departure is being watched, tested, and where its usefulness is proved, adopted by the Post Office; and that they cannot with advantage quicken the natural evolution of telegraph methods by any specific recommendation.

Provision of relief circuits.

81. The Morse system, however, holds the field for the time being, and the Committee have considered whether they should recommend the provision of relief circuits other than Morse at which officers who are suspected to suffer from an early stage of cramp can be temporarily employed. It has already been shown that these early symptoms may be subjective only, and the difficulties of diagnosis have been pointed out (*see par. 13*). A telegraphist who alleges difficulty in Morse keying should have a rest from such work. The difficulty may be caused by temporary loss of confidence, or by some local condition, and, if so, should disappear after a rest; but if the difficulty is due to cramp it may be expected to return as soon as Morse keying is resumed; and if cramp is really present, complete recovery in the affected hand is improbable. The Committee consider it important that the employment thus given as a relief from Morse working should provide a full day's work, and not be "preferential" in the sense that a telegraphist would prefer it to his ordinary work. If it is in any way "preferential," it would offer a serious temptation to operators to feign difficulty in keying in order to obtain a better or easier duty.

Hughes, Baudot, and Double Plate Sounder circuits.

82. The Committee have considered various suggestions for the provision of suitable relief employment. Hughes and Baudot instruments offer little scope, and in view of the time required to reach proficiency in their manipulation, these instruments would not be suitable for the purpose. Double Plate sounder circuits would be more suitable, but they are few in number; and the Committee are not prepared to recommend the re-introduction of these instruments, even to a limited extent, in view of the administrative and engineering objections to such a course, wherever it is possible to find equally suitable work in other ways.

Punching.

Hand-punching duties in connexion with Wheatstone working should provide many opportunities for the temporary employment of telegraphists who may be suffering from cramp; and if the telegraphists have a knowledge of typing they can be set to work keyboard perforators or to type messages for delivery.

Telegraphists should be encouraged to learn typing.

The Committee strongly recommend that such telegraphists should be encouraged to learn typing in order to increase the opportunities of finding work for them. It is, in the Committee's opinion, to their interest to acquire skill in this art of their own accord and in their own time without waiting for official instructions.

Phonogram circuits and telephone duties.

Phonogram circuits can provide work for female telegraphists; and men might also be employed at these circuits, although the work cannot be regarded as worth the pay of a male telegraphist. Female telegraphists can also be employed on the simpler telephone duties if they are physically fit to do them.

It was shown in paragraph 76 that, in America, telegraphists who have difficulty in using ordinary Morse keys resort to the use of semi-automatic keys; and if these keys are found with further experience to be satisfactory under the conditions prevailing in this country, their use should enable relief circuits to be provided without difficulty for telegraphists suffering from cramp. Semi-automatic keys.

83. The Committee attach importance to the use by telegraphists of chairs with seats of suitable height. When a telegraphist is keying, the elbow must stand out a little from the body to admit of a free up and down movement of the wrist, which would not otherwise be possible. This involves a raising of the elbow; but the elbow should not be raised more than is necessary to get free wrist movement; and the seat should be of such a height that the forearm is then horizontal. If the seat is too low, the elbow has to be raised to an uncomfortable degree; and the strained position will cause fatigue and may lead to cramp in a telegraphist predisposed to the disease. The Committee's enquiries show that chairs with seats ranging in height from 18 inches to 21 inches should meet requirements. A chair with a seat adjustable as regards height would be the best arrangement, if such a chair could be made rigid enough. The adjustable chairs supplied by the Office of Works for the use of typists are not wholly satisfactory in this respect, but they are understood to be preferred by many typists to chairs with fixed seats; and the Committee recommend that chairs of this kind should be placed in instrument rooms, particularly where women are employed, for practical trial, and that as soon as a suitable type of chair has been approved it should be adopted for general use. Chairs.

SUMMARY OF RECOMMENDATIONS.

84. The chief recommendations of the Committee are summarized below:—

I.—*Recruitment of Telegraphists.*

Recruitment of established telegraphists from Boy Messengers and Girl Probationers (subject to certain educational conditions) can with advantage be increased; and those selected should be chosen primarily for their aptitude in telegraph work. Telegraph instruction should form part of the secondary education given to them. The most apt should be picked out and their training continued until they are qualified, when they should be appointed direct as Sorting Clerks and Telegraphists after passing a qualifying examination of a general character (par. 52). Summary of recommendations.

So far as the class of learners recruited from outside is concerned, the limits of age for entry should be 14 to 16 at all offices, excepting only at those where postal exigencies make an extension of age necessary, and at such offices the limit should be 17 years (par. 53).

II.—*Subjects of Examination.*

Typing would be a suitable subject to add to the examination (par. 53).

III.—*Medical Examination.*

Medical officers should be instructed to pay particular attention to the nervous condition of candidates, and to the occurrence of insanity, hysteria, or epilepsy in the family. Candidates who show signs suggesting permanent nervous weakness should be rejected. The presence of stiff wrists and heavy clumsy hands, and inability to write easily, should also be considered (par. 54).

IV.—*Rejection for Inaptitude during periods of Learning and Probation.*

Attention should be paid to a learner's aptitude throughout the whole periods of training and probation, and no person should be appointed to the establishment who is not likely to make a good telegraphist. The attention of candidates should be specially directed to the regulation regarding dismissal for inaptitude, and this regulation should be strictly enforced. Rejection, where necessary, should take place as early as possible; and a qualified and experienced officer should report after a learner has been under training for three months, and also where required at later stages, whether the learner is suitable or not (par. 55).

Learners or probationers rejected for inaptitude who have already spent some years in the service of the Post Office should be given, if possible, opportunities of entering some other branch of the service (par. 55).

V.—*Training of Learners in Telegraphy.*

A general uniformity of teaching conditions and methods (within practicable limits) is to be desired throughout the country. No learner should be employed at any office where correct instruction by a competent instructor on proper apparatus cannot be given; the creation of teaching centres is recommended; and at such centres, as far as possible, two or more learners should be placed under training together (par. 58).

Qualified instructors should be chosen, and arrangements made for them to give regular instruction. The same officer should remain on instruction duty for not less than four years (par. 59).

A Morse printer should be supplied for practice wherever a learner is under training; and a full practising set should consist of a Morse printer and a Morse sounder in the form of a "two-station circuit." Double current keys should be generally used in the training of learners, and single current keys in addition where more keys than one are required. Practising sets should be permanently fixed at offices where learners are always under instruction, and an increase in the number of such offices is to be encouraged. The Surveyor should have at his disposal a stock of apparatus for use at other offices as required (pars. 58, 59, 60).

The card of instructions for sending should be revised (par. 56), and methods of training improved (pars. 61 and 62).

A learner's qualifications should be judged by the number of messages sent and received in one hour instead of by the number of words sent and received in one minute (par. 63).

The training of learners at "amalgamated" offices in each Surveyor's district should be under the supervision of a specialist in telegraphy (par. 64).

Ambidexterity should be encouraged (par. 65).

VI.—*Organization.*

Supervising officers should be instructed to see that telegraphists under their control are working at a proper speed and in an approved style, and to give immediate relief to young telegraphists who have difficulty in working (par. 66).

Young telegraphists should not be employed at first at heavy and difficult circuits (pars. 45 and 67).

Senior telegraphists should not be employed exclusively on the heavier Morse duties (par. 67).

Continuous working in one direction should be limited to two hours (par. 67).

Telegraphists who begin to have difficulty in Morse sending should have a rest from this kind of work, but the relief employment given to them should not be "preferential" (par. 81). They should be encouraged to learn typing (par. 82).

An official statement should be issued explaining the use of the telegraph annual return (par. 31).

Local controlling officers should frequently ascertain the working average at their offices, so that undue stress upon a staff may be dealt with promptly (par. 32).

VII.—*Instruments, &c.*

The use of the double current type of key on important circuits where the sending duty is heavy and continuous should be extended (par. 70).

Double current keys should be adjusted to a specified standard of lever play and spring tension; and officers of the Engineering Department who test these keys should have a practical knowledge of telegraphy (par. 71).

The trials of semi-automatic keys (Vibroplex, &c.) should be continued, and an extension of the use of these keys should depend on the result of their further working (par. 77).

The use of machine telegraph systems, as substitutes for the Morse, should continue to be developed as speedily and extensively as practical experience warrants (pars. 79, 80).

Steps should be taken to provide the standard space allowed for each kind of instrument (par. 48).

Chairs with seats of suitable height should be used by telegraphists. An adjustable chair of suitable type should be adopted for general use where needed (par. 83).

Conclusion.

85. The investigations of the Committee, extending over a period of some 18 months, have led them into certain spheres of postal service where information and evidence had to be gathered for the first time. They venture to hope that the time

thus spent may be justified by the incidental usefulness of this information to the general service of the Post Office. So far as this information bears directly on the subject of their present enquiry, it reinforces the conclusions suggested by the evidence on the immediate subject of cramp—namely, that as the trouble is not attributable to any one single cause, so there is no single or royal road to a remedy for it. Any violent and sudden alteration in methods of recruitment, conditions of work, or use of instruments, might merely destroy the present fabric of telegraph working; and no such course appears to the Committee to be either practicable or desirable. Moreover, it would be idle to pretend that, while manual work on telegraphic instruments continues, the risk of breakdown in the case of some operators can ever be completely eliminated. In this respect telegraph working is on a par with all other forms of specialized manual labour conducted under conditions of speed and occasional stress.

Nevertheless, the Committee hold the strong opinion that the cumulative result of the recommendations summarized above, if adopted, should have, even from the first, and to an increasing degree as time goes on, a marked effect on the incidence and prevalence of telegraphists' cramp. The admission into the service of fewer unsuitable learners—the more uniform tuition, under close and careful watching, of those who are admitted—the more rigorous protection of young workers from conditions of undue stress—the steady substitution of mechanical forms of sending for the finer muscular movements demanded by the Morse instrument—the discovery and use of fresh forms of variation and relief for operators: all these elements in combination may be expected to contribute their share towards a reduction in the number of operators affected in greater or less degree with telegraphists' cramp. The Committee are satisfied that that number, though serious enough to demand careful and sympathetic administrative action, is confined within the limits already given, and they look forward with confidence to its steady diminution in future years.

86. In conclusion, the Committee have much pleasure in expressing their thanks to the Secretary, Mr. Paterson, for the valuable assistance which he has rendered to them throughout the enquiry, and they desire to record their high appreciation of the ability and zeal with which he has discharged the heavy work entailed by their proceedings.

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S. A. PATERSON (*Secretary*).
31 October 1911.

APPENDIX No. 1.

Report of Medical Sub-Committee

DEFINITION OF TELEGRAPHISTS' CRAMP.

Craft neurosis, occupation spasm, trade palsy, are the various names given to indicate a group of functional disorders which are characterized by a difficulty in the performance of the specific coördinated movements of certain occupations.

The occupations in which the affection occurs are, for the most part, complicated acts brought to perfection by education and practice. The form of occupation spasm most commonly met with is writers' cramp, but many other forms exist, such as the cramp (manual and labial) of players of musical instruments (violin, piano, flute, &c.), the cramp of cigarette makers, and many others.

Any instrument which calls for repeated fine muscular movements of the same kind may involve a relative "occupation spasm" or "craft neurosis." We have associated the term telegraphists' cramp with the disease which brings about a difficulty in making the specific coördinated movements needed for a proper manipulation of the particular instrument known as the Morse key, but the manipulation of the Baudot or Hughes keyboards* may similarly bring about their relative cramp (analogous to pianists' cramp); and all these three cramps are on parallel lines with writers' cramp. The various members of the group can be distinguished from one another by the fact that the pain and spasm occur only during use of the particular instrument on which the disabled worker has been employed; and disability in the use of one instrument does not necessarily imply disability in the use of any other instrument. A few exceptions to this general rule have been found in advanced or long-standing cases. (See Case 3, Appendix A.)

In its medical aspect, before any cramp or spasm is apparent, there may be a stage characterized by subjective symptoms only, when the operator feels pain or discomfort in the operating hand or arm. The pain is referred to various parts of the limb, but it is constant in its time of appearance—that is, it occurs when the operator begins to key or soon afterwards, before any muscular fatigue is possible; and this is the only circumstance which enables this pain to be distinguished from pain caused by fatigue. The operator's electrical reactions are normal, and his muscular and nervous condition, so far as can be ascertained, is normal in all respects; and his work does not suffer. There is no visible cramp or spasm; visible cramp or spasm may or may not develop; and, although this condition cannot therefore properly be called telegraphists' cramp, we are of opinion that it marks an early stage of the disease.

The characteristic feature of the disease—implied by the term "cramp" itself—is an "involuntary violent and painful contraction of the muscles"†; and throughout the telegraph service such visible spasm is regarded as the mark of the disease; and telegraphists' cramp may be defined as a disease of the central nervous system characterized by visible spasm of hand ^{and} or arm during the manipulation of a telegraph instrument, and by impairment of the power of making the specific coördinated movements needed for such manipulation.

METHODS OF INVESTIGATION.

(1) An examination has been made of certain well-marked cases of telegraphists' cramp who appeared before the Committee for the purpose of demonstrating the disorder.

In all, 17 cases were examined, all of whom had been reported as cases of telegraphists' cramp.

* Other telegraph instruments.

† Sir J. A. H. Murray's New English dictionary.

In the majority of cases the symptoms came on without any definite exciting cause; but in several cases the onset was attributed to excess of Morse sending work, *e.g.*, on press wires or specially heavy circuits.

The length of service in those cases considered by us to be true telegraphists' cramp was long—28, 25, 22, 19, 19, 15, 12, 10, 7, 6 years—an average of 16 years.

A very important point which was elicited by our enquiry was the ability of the subjects of Morse cramp to perform other actions besides Morse manipulation and to use other instruments than the Morse. This, we found, did not depend on the total length of service, for operators who had developed cramp after many years' service on the Morse were found to be able to use the Hughes instrument; but in those cases where pain and stiffness and spasm had occurred and the operators had continued work for long periods while suffering from cramp, movements of the hands other than those used in Morse sending became affected, and the Hughes instrument could not be used.

Difficulty only in sending on Morse Instrument.

Period of operating	- 22 years	28 years	12 years	10 years
Period of cramp	- 2 „	1 year	1 year	1 year

Difficulty in Morse sending, and other actions of the hands affected so that other Instruments could not be used.

Period of operating	- 19 years	25 years	19 years	15 years
Period of cramp	- 10 „	15 „	6 „	9 „

This shows that, where the operator brought his case to notice early, he could be usefully employed at the Hughes; but when, in spite of disability, he persisted in doing the work, the spasm extended to other actions beyond the special one of Morse sending.

A most careful examination was made of six of these cases. The nervous system was completely investigated and was found to be normal. No muscular wasting and no alteration in the electrical reactions was found. No alteration in sensibility of the skin of the hands or of the deeper structures was discovered. Such a result points to the disorder being of a central origin and not to any failure in the muscles or in the sensori-motor peripheral mechanism. In Appendix A a full account of six cases will be found.

(2) By order of the Committee, a circular with a set of questions to which answers were invited was sent to each of the 8,153 Telegraphists employed either in the Central Telegraph Office or on the telegraph side of all provincial offices which have a separate telegraph staff. A copy of the form employed is contained in Appendix B.

Answers were received from 7,317 Telegraphists. 836 forms were not returned or returned without reply.

The answers from the "F" Division of the Central Telegraph Office were first examined and tabulated. The Committee chose this division as representing a mean between those divisions where Morse working is predominant and those where little Morse working is done. 155 Telegraphists (out of 182) answered the questions asked, and 100 made complaint of difficulty in keying. Of the 100 complaints, 14 suggested cramp proper, 19 an early subjective stage of cramp, and 67 muscular fatigue or other causes of difficulty.

148 Telegraphists of this division—both those who complained of difficulty in manipulation as well as those who did not, in fact all who were available—were then personally examined by ourselves. Their physical well-being was enquired into, the state of their arm muscles was examined, and their method of manipulation at the key was watched. A sentence was keyed, printed in Morse signals on slip, and examined. Mr. W. T. Smith, Traffic Manager, and Mr. R. H. Davis, a member of the Committee, kindly assisted us in this part of the examination, and gave us the benefit of their expert knowledge.

The result of this enquiry is shown in Appendix C. 93 Telegraphists complained of some difficulty in keying. 13 of these were found to be affected with the malady. Of these 13 cases, seven showed definite spasm in the right hand, but in the remaining six the disease was in the early or subjective stage. In these latter cases, however, the diagnosis was made after full consideration of the statements of the operators and their physical condition. The average length of service of these

13 operators at the Morse key when disability first appeared is 15·6 years. It is to be particularly noted that, of these 13 officers, not one was disabled from performing his allotted duty. Moreover, some of them, though conscious of difficulty, yet had not thought that they had cramp. In all these cases the cramp had affected the right hand only; five of them worked quite comfortably with the left, and five used the left hand occasionally to relieve the right; but all were able to perform their work to the satisfaction of the supervising officers.

In none of these cases were there any local abnormalities, the muscles were healthy and well developed, and there was no loss of power or sensation in the arm or hand.

In Appendix D is an analysis of the written replies received from operators exclusive of the "F" Division of the Central Telegraph Office.

In this analysis an attempt has been made to differentiate between the subjects of visible cramp and those whose complaints suggest the presence of the malady in an early subjective stage.

The replies* of the 7,162 telegraphists, which were reviewed with the utmost care, show:—

404	{	313	cases suggesting "cramp."
		91	" " the early subjective stage of cramp.
		2,360	" of fatigue.
		4,398	" in which no complaint was made.
		7,162	

The figures show that over one-third of the staff profess to feel more or less difficulty in manipulation, but it is necessary to emphasize the fact that in most cases the difficulty is slight, of a temporary character, and attributable to muscular fatigue alone.

The answers received from the "F" Division of the Central Telegraph Office show a very much larger proportion of complaint. In the 155 forms returned, there were 100 cases of complaint; and, in these, 33 answers were returned where the difficulty appeared to be due to cramp. The personal investigation made by us reduced this to 13 cases. Thus it is probable that the number of operators apparently suffering from cramp must be considerably reduced to obtain those who are actually cramp subjects. It does not, however, follow that this reduction must be proportional to that necessary in the case of the "F" Division, for the answers received from the country at large were examined after the personal examination of the "F" Division. It is thus possible that the knowledge gained by our examination and comparison of the statements made by those telegraphists, and the subsequent personal inspection of the men themselves, may have enabled us to make a better discrimination of the statements from the country at large.

The whole of the †417 cases where the replies received and personal examination made indicated that the difficulty was apparently due to cramp, are those of operators on the Morse key. In the Cable Room of the Central Telegraph Office replies were received from 105 telegraphists, and though some complaints of fatigue were made, we considered that in the Cable Room, where Hughes and Baudot instruments are mainly used, true cramp was absent. Hughes and Baudot instruments are little used except in the Cable Room, whilst the Baudot instrument has only been introduced within the last few years.

The above result seems to show that in England the malady is chiefly associated with prolonged sending with the Morse key. This is no doubt due, in some measure, to the fact that the Morse key is the prevailing instrument. Partly, as will be shown, it is due to the fact that its use necessitates monotonous and unvarying movements. In Germany, where the use of the Hughes instrument is more prevalent, Cronbach has described several cases of cramp in workers on the Hughes instrument.

• Replies from staff exclusive of "F" Division	7,162
Replies from "F" Division	155
Total	7,317

† Written replies suggesting cramp (excluding those from "F" Division)	404
"F" Division	13
Total	417

Appendix E shows the length of service in years when difficulty was first experienced at the Morse key.

Of the 417 cases, only 243 answered the question dealing with this point; it is possible, had replies been received from all, that the incidence of the malady as regards service would have been different, but the available statistics show the following results:—

Years' Service.	Male.	Female.
1-5 - - - - -	22	20
6-10 - - - - -	39	23
11-15 - - - - -	42	8
16-20 - - - - -	51	5
21-25 - - - - -	23	1
26-30 - - - - -	5	—

It will be noticed that, in the case of the female staff, the malady is more apparent at an earlier period of service; and as the result of our investigations we find that the affection may seize upon the young telegraphist or on one who has had comparatively little manipulation to perform.

Appendix F shows the number of cramp subjects who are ambidextrous. 39 officers were ambidextrous before developing cramp, 259 acquired ambidexterity after developing cramp, and 117 are not ambidextrous.

Appendix G shows the number of cramp subjects who, as learners, received regular instruction in telegraphy. The subject of the tuition of learners is being dealt with specially by the Committee.

Appendix H has reference to complaints about keys. This subject also is being dealt with by the Committee.

Disability arising from the use of the Pen.—In our examination of the 7,317 replies, we do not find any instance of writers' cramp, though we noticed several cases of fatigue and consequent interference with easy penmanship.

REMARKS ARISING FROM THE INVESTIGATION, INCLUDING A NOTE ON "PREVALENCE."

In every office there are some telegraphists who make complaint of having difficulty in the performance of their duty at the Morse key. It is possible to divide these cases of disability into three classes:—

- I.—Disability the result of true cramp.
- II.—Disability the result of fatigue.
- III.—Disability arising from nervousness of temperament, self-consciousness, working at too high a speed when first placed at a circuit, and general unsuitability for telegraphic work.

I.—*Disability the Result of True Cramp.*

Cases of this character present certain definite symptoms and signs. Pain, aching, or stiffness, or a combination of all, is felt in the operating arm, which pain may be variable in position but is constant in its time of appearance, occurring as soon as, or within a short period after, the operator begins to key, before any fatigue is possible. In the more advanced form of the disease visible spasm of fingers, wrist, or arm, or of a combination of two or more of these parts, is present.

If the symptoms, which may be regarded as a warning, are neglected, if work at the Morse key is persisted in, the feeling of pain, aching, and stiffness may be followed sooner or later by some loss of the power of free manipulation. The operator finds a difficulty in signalling some particular letter or letters. This mal-coördination becomes persistent, and it cannot be avoided by voluntary effort unless the rapidity of the manipulation be greatly reduced. The mal-coördination sometimes affects the extensor muscles alone, sometimes only the contractions of the flexor muscles are altered, but most commonly both. We find that the feeling of discomfort generally affects the extensor aspect of the forearm first. The fingers may next feel a little cramp, but since their position may be varied considerably they are not prominently affected.

The onset of the malady may be sudden. We have examined a telegraphist who told us that, after a heavy spell of work on the Morse key, he suddenly felt "something go wrong" with his right hand, that almost complete disability for signalling followed at once, and that there had been no recovery. This telegraphist

is a strong, able-bodied man, and his style of sending is good; his manipulation of the key with the right hand is interfered with at once by spasm, and the slip shows great irregularity. He performs his duty with the left hand.

We may here quote from Dr. Fulton's* description of signs displayed by cramp subjects, with which we concur.

"The knob of the key, instead of being loosely encircled by the fingers, is seized firmly; the spasm of the opposing muscles increases; and the movement is gradually transferred from the wrist to the elbow as the higher flexors and extensors come to replace those which are disabled below. If the manipulation be persisted in the spasm spreads further and further up the limb, and every muscle that attempts the movement is rapidly affected. The elbow, acutely flexed, is adducted, elevated, and carried forwards; and the operator, instead of facing the instrument, sits sideways, with his right shoulder bent over the key. The movement is now almost limited to the shoulder-joint; the whole arm makes exaggerated movements; the key, instead of receiving a tap, gets a heavy blow; and thus the manipulation, instead of being nimble and easy, becomes slow, laborious, and painful."

The following account of a bad case is given by Dr. Fulton:—

"This operator, who had suffered for years, found it necessary to flex the right thigh, and, grasping the edge of the table with his left hand, twisted himself over the instrument in an attitude eminently ludicrous. Each thump was accompanied by a lurch forward of the head and back, and so closely were his mind and energies involved that he could only articulate Yes or No in reply to a question. If he had to utter a sentence he had to stop his manipulation."

We have seen cases presenting exactly similar signs.

Officers suffering from cramp may continue working at the instrument for years (1) by working more or less slowly; (2) by relieving the work of the right hand by the use of the left; (3) by varying their method of manipulation of the key; (4) by supporting the elbow; or (5) by holding a small object, such as a pencil, between the fingers. One of the most striking features of our enquiry is that a telegraphist may continue to do work that will pass muster in spite of very severe cramp. The receiving telegraphist will be able to understand the "sounder" although the sender may be writhing in contortions as he sends, and his slip will be almost illegible. In many cases cramp is confined to the right hand, the telegraphist being able to use the left hand for months or years, but in many cases the left hand becomes affected eventually.

The pain, or spasm, or both combined, never disappear or grow less if the work of the right hand is persisted in. The condition tends to grow worse.

In addition, besides spreading to other limbs, the spasm may spread to other actions, and the power to perform acts of a less fine character may be impaired or lost—the power to hold a pen, to button clothing, to lace boots, to use a knife and fork, a needle, a razor, a walking stick—specimens of all these disabilities have been met with.

It is probable that only an extremely small proportion are totally disabled from Morse sending. The incidence of the affection among telegraphists generally appears to be no more than that of writers' cramp among copyists, and the two conditions are strictly comparable.

Cramp may affect any Morse telegraphist; it is not necessary to be of a neurasthenic temperament or of poor physique to fall a victim to it, though its incidence is more likely to fall on people of poor or impaired health, of poor physique, or of nervous temperament.

In making a diagnosis we are of opinion that it is necessary firstly to be satisfied that the complainant is a qualified telegraphist (that is, that he has passed the stage of tuition and has taken duty at a circuit), next that there is an absence of local disease.

The pronouncement of the Home Office Committee indicates that, for the purposes of the Act, the malady which should be viewed as cramp is that in which there is an absence of local abnormalities. "Telegraphists' cramp might be confused with "temporary or permanent reduction of manipulative skill, or local muscular weakness, "with neuritis and other nervous disorders, and even with rheumatism."

Since telegraphists' cramp is characterized by visible spasm, it should be possible to determine by personal examination of the staff whether an officer is affected or not. This personal examination should be conducted by a medical officer in conjunction

* See section on "Literature," page 45.

with a telegraphic expert. The telegraphic expert would point out bad style of manipulation, distinguishing a bad style due to defective training or personal idiosyncrasy from a bad style due to difficulty in sending; and the medical officer would distinguish difficulty due to cramp from difficulty due to local causes, such as muscular weakness, rheumatism, or neuritis, or to generalized diseases of the nervous system which might simulate cramp.

A determination of the early subjective stage would be more difficult. The medical officer must needs trust the good faith of the telegraphists concerned, and to detect malingering his medical skill must be supplemented by his general shrewdness. There might often be no reason to doubt a telegraphist's statement, but a neurasthenic telegraphist might believe difficulties to be real which existed only in his imagination, and occasionally an officer who wished to give up operative work might feign the symptoms of cramp.

We feel that we cannot do better at this point than quote in full the portion of Dr. Fulton's paper which describes the Morse instrument and the physiology of the movements attaching to the work of the operator.

"*The Morse.*—This is the common instrument The transmitting part, called the 'key,' consists essentially of a lever moving on a hinge fulcrum. The proximal arm is surmounted by a knob, and is kept elevated by a spring which depresses the distal arm. The manipulation consists in a succession of depressions of the proximal arm against the resistance of the spring. The range of movement of the key varies from about $\frac{1}{2}$ to $\frac{1}{8}$, or even $\frac{1}{3}$ of an inch, and the resistance of the spring varies from two to four ounces.* The thumb, index, and middle fingers of the right hand are applied somewhat loosely to the knob, and are held more or less rigid in a position of flexion and opposition; but they may be varied a little. The movement is one of flexion and extension, and takes place chiefly at the wrist, but slightly at the elbow, and in part also at the metacarpo-phalangeal joints of the index and medius; these fingers being slightly raised from the knob between each group of contractions which form a letter. The muscles called into play in the upward movement are the extensors of the carpus and of the digits, particularly that part of the common extensor which commands the index and medius, and the special extensor of the index. The extensors of the thumb are also involved. The downward movement is produced by the flexors of the carpus and of the digits, especially those portions of the common flexors which act on the index and medius. And, further, since these fingers and the thumb are maintained in a position of flexion and opposition, there is slight, constant, but variable contraction of the adductor, opponens, and flexores pollicis of the carpal extensors and of the flexors of the digits mentioned. It is probable that the interossei and lumbricales are also brought into operation. The triceps and the flexors of the forearm are also implicated. Each depression of the key establishes an electric current, which, flowing along the wire to the receiving instrument, passes into a coil enclosing a soft iron core, which, therefore, is transformed into a magnet so long as the current continues. Suspended on a hinge above the coil is a horizontal lever, the proximal end of which bears an armature which is pulled down every time the core is magnetised, and is elevated in the intervals by a spring. The distal arm carries a thin revolving wheel, and this wheel, while partially immersed in an 'ink-well' below, comes into relation above with a strip of paper kept moving at a definite rate by means of clockwork. Thus, it will be observed that the transmitting lever and the recording lever move synchronously and in unison. Each time the key is depressed the core is magnetised, and the ink-wheel, pressing against the running slip, produces a linear mark whose length is equal to the duration of the depression of the key, and, therefore, to the duration of the flexor contraction. Similarly, the length of the interruptions between the linear marks represents the duration of the elevation of the key, that is, of the extensor contractions. Hence it follows that the recording slip presents us with an accurate myographic picture of the number, kind, duration, and relativity of succession of the muscular contractions.

"For instance, the word 'telegraph'—

t e l e g r a p h

— . . — . . . — . . — . . — . . — . . —

requires fifteen short and eight long flexor contractions, and fourteen short and nine† long extensor contractions, in an order represented above. The alphabet of the Morse

* Note.—With double-current keys the play now given is $\frac{1}{8}$ of an inch, and less than that with single-current keys. The spring resistance varies at present from 4 to 10 oz. The Committee are desirous of suggesting a standard range of spring resistance.

† Eight long contractions for the spaces between letters and a still longer one for the word space.

language is made up of two types of flexor and three types of extensor contractions.

"The limitation of the range of movement, the great number of the contractions, their rapidity, difference of duration, and variability of succession, constitute the important and differential features of the Morse manipulation. When the contractions are properly coördinated we get what may be called the normal Morse language."

A recent experiment by ourselves, based on an average of 20 words a minute, is described in the following paragraph.

Assuming that a telegraphist works at the rate of 20 words, each of five letters, in a minute (an average rate of transmission), it is found by experiment, taking the dot as the unit and the word "telegraph" as a basis for the relative proportion of dots to dashes, that the number of contractions per minute and the time occupied in each contraction is as follows:—

Flexor Contractions.				
Short	-	-	-	165, each lasting 0·06 per second.
Long	-	-	-	88, " 0·2 "
Extensor Contractions.				
Short	-	-	-	154, each lasting 0·06 per second.
Long	-	-	-	88, " 0·2 "
Longer	-	-	-	20, " 0·3 "

Thus in one minute there are 253 flexor contractions and 262 extensor contractions; that is to say, 515 different muscular contractions must occur in one minute when sending on Morse at the rate of 20 words a minute.

Of course, this rate does not continue, periods of rest from telegraphing intervening between the active muscular movements. In Appendix I. is a comparative statement of the movements made per minute by typists and telegraphists respectively, which has been worked out independently by Mr. Purves, a member of the Committee. From this it will be seen that a telegraphist on the Morse instrument makes more than twice as many movements per minute as a typist.

CAUSE OF TELEGRAPHISTS' CRAMP.

Cramp is the result of a weakening or breakdown in the central controlling mechanism of the brain, resulting in spasm and incoördination of the muscles which perform the specific act of telegraphy.

It is possible for telegraphists to suffer from cramp as a result of working on any telegraphic instrument. In the United Kingdom the Morse key is the common instrument used, and the vast majority of cases of cramp are found in telegraphists working on this key. It has been shown that the use of this key requires a very large number of muscular contractions with a very limited range of movement and character. It is possible that these facts may influence the occurrence of cramp in workers on the Morse key. However, in Germany cases of cramp on the Hughes instrument seem not uncommon. It is probable from our knowledge of craft neuroses in general that the malady may arise during work on any instrument, but there seems ground for thinking that Morse working may specially predispose to cramp for the reasons stated above.

The conclusion that the central nervous mechanism is at fault has been reached as the result of our examination of a large number of cases of cramp. The muscles of the telegraphists affected were perfectly healthy, and gave the normal reactions to electrical stimulation. Sensibility of the skin and deeper structures of the hands was quite normal. No symptoms or signs pointed to an affection of the nerves, or of the arms or hands. Thus, by a process of exclusion, we conclude that the central nervous mechanism must be at fault.

To the view that the central nervous mechanism is at fault an objection has been raised because of the undoubted fact that the subject of cramp complains of pain in the affected arm at an early stage of the disease. It has, therefore, been argued that the origin of the disease must be a local one. As far as our investigations carry us, we find that there is no change whatever in the state of the skin; and the pain complained of always seemed to us to be situated in the muscles and not in the skin itself. It must be remembered that the muscles are structures containing sensory nerves; and over-action, strain, ill-balanced movements, or spasm will stimulate these sensory nerves, and pain will be experienced which will be referred to the muscles affected. We consider that the origin of the disease is a weakening of or a breakdown

in the controlling mechanism in the brain, and this breakdown results in over-action and incoördination of the muscles which are used in the particular act of telegraphy, and that it is these irregular strains in the muscles which are the cause of the pain experienced by the cramp subject in his hand and arm.

The fact that the malady is apt to attack the left hand if persistently used after the right hand has become affected, and that it may spread to other limbs, and in aggravated cases to other actions, is also a strong argument in favour of the disorder being of central origin.

This breakdown in the central controlling mechanism of the brain is essentially different from muscular fatigue. The latter may affect a perfectly healthy telegraphist, and supervenes upon a prolonged period of work. After a night's rest, however, all pain and stiffness will have disappeared, and the telegraphist is able to perform his ordinary duty without any trouble on the following day.

In the subject of cramp, however, the disability is often experienced as soon as the key is touched, *i.e.*, long before any fatigue of the muscles could have developed. At the same time we consider that muscular fatigue, when endured over long periods, is an important provocative cause of the central breakdown. A nervous disposition, outside worry, and sudden extra strain may also be other factors which may induce the onset of telegraphists' cramp. The constitutional state of the operator must be taken into consideration equally with the act of telegraphy as a cause of cramp; the first may be regarded as the predisposing cause, and the second as the exciting cause, of the condition.

II.—Disability the Result of Fatigue.

Cases of this character were met with in this enquiry. These must be differentiated carefully from those of disability due to cramp.

The cases of disability arising from fatigue may be divided into two classes:—

- (1) Fatigue without local aggravating causes.
 - (2) Fatigue with local aggravating causes.
- (1) *Fatigue without Local Aggravating Causes*:—
- (a) Of the healthy.
 - (b) Of the neurasthenic, alcoholic, and of those temporarily weakened by ill-health.
- (2) *Fatigue with Local Aggravating Causes*:—
- (a) *Local Personal Causes*.—Brachial neuritis, tenosynovitis, rheumatic or gouty affections of the upper limb, ganglions, accidents to the arm with resulting weakness or impairment of power, bad style of manipulation (the result of bad tuition or acquirement of a bad style), or want of practice from various causes such as changes of duty and transfer to other branches.
 - (b) *Mechanical Causes*.—Faults in keys (bad adjustment of the amount of play in the signalling lever and of the spring tension), the holding of pencils, manifolding, faulty arrangement of seats and tables in height, alleged faulty positions of keys in quadruplex circuits, insufficiency of space on tables, and faulty position of keys on table.

In the case of fatigue without aggravating causes, the arm-ache which follows is of temporary or occasional character, appearing after some hours of duty, and disappearing after a night's rest, or with improved health, or with return of skill after practice; if, however, aggravating causes exist, disappearance of the symptoms follows only on improvement in the local disease of the muscles or nerves, or on correction of the manipulative or mechanical faults. The fatigue in these cases is of local origin; jerkiness or illegibility may appear as the result of the conditions; but these do not appear until the arm is tired.

In any given case personal, local, and mechanical causes may be combined as aggravating causes producing fatigue.

The question of overtime as a cause of fatigue has been carefully considered by us. We found that the busier months of the year were June, July, August, and September, and that in the Central Telegraph Office the greatest amount of overtime performed by any one officer during this period was somewhat over two hours a day, and that upon the average officers rarely performed over one hour a day overtime. We therefore consider that the overtime worked does not appear to be excessive, but we would suggest that a careful watch be kept by the supervising officers to see that no operator performs an excessive amount of overtime.

III.—*Disability arising from nervousness of temperament, self-consciousness, work at too high a speed when first placed on circuit, and general unsuitability for telegraphic work.*

Disability from these causes is found in young operators when first entering upon their period of service as established workers. Several cases of this nature were brought before the Committee and were examined by them. Moreover, during our examination of the "F" division, in conjunction with telegraphic experts who have been in the service of the Post Office for many years, we were much struck with the fact that several cases of cramp which we examined had been known to one of them (Mr. Smith) during their whole telegraphic career. In several of these cramp cases he said that the operators affected had never been expert telegraphists; he had watched them through their entire career, and had attributed the onset of cramp in large measure to the fact that they had never been expert in sending. We have reason to think that certain shaped hands are unsuitable for telegraphic work, and that many telegraphists, after going through their period of learning and their period of probation, are not suitable for telegraphic work, and are thus more liable to develop cramp during their career. It would therefore be advisable that, after three or six months' tuition, a report should be made primarily by a telegraphic expert, and later, if necessary, by an experienced medical officer in conjunction with him, with a view to coming to a conclusion whether or not the learner will probably be able to discharge his duties efficiently as a telegraphist.

About 5 per cent. of cases are recommended for rejection by the medical officers of the Post Office at the medical examination which precedes appointment. It should be noted, however, that, of 76 candidates so rejected during the last two years, 24, or about one-third, were admitted to the service after appealing to the Civil Service Commissioners.

PREVENTION OF CRAMP.

For prevention of cramp we submit the following suggestions for consideration. These suggestions may be grouped under three heads:—

(A) *Suggestions as to the selection and tuition of candidates for telegraphic situations.*

1. Careful selection of the staff on appointment, and a thorough examination by a medical officer and a telegraphic expert during the probationary period. This examination should be specially directed to the exclusion of learners with temperamental or physical unfitness.

2. A previous knowledge of typing is to be recommended as some indication of an aptitude for telegraphic work.

3. Ambidexterity of learners should be encouraged.

4. Improvements may be made in the method of tuition and in the organization of the teaching in schools.

(B) *Organization of general work.*

1. Limitation of the hours of Morse sending.

2. Alternation of instruments.

3. Encouragement of the staff to report symptoms of difficulty in sending as soon as possible.

4. Attention to general health.

(C) *Improvements in instruments and apparatus.*

1. Regular adjustment of instruments by skilled officers.

2. Standardization of the range of spring resistance in the keys.

3. Correction of faulty arrangements in desks and chairs.

We have shown that the nervous breakdown known as telegraphists' cramp is the result of two factors, one a nervous instability of the operator, and the other the occurrence of prolonged fatigue during the complicated muscular movements required for Morse sending. This fatigue is relative to the nervous state of the operator and not to the amount of work performed.

If the conditions which lead to fatigue and are above enumerated can be remedied the personal factor alone remains as a cause of cramp; and this can only be eliminated by a careful and judicious selection of the staff.

LITERATURE.

The earliest description of telegraphists' cramp as a specific disease was by M. Onimus* in Belgium in 1875. He gave a clear account of the symptoms and associated the complaint with the use of the Morse key. He says, "Cette affection ne serait pas très rare parmi les employés au télégraphe, surtout pour ceux qui se servent constamment du télégraphe Morse; ils la désignent entre eux par l'expression de mal télégraphique." M. Onimus recommended alternate duties upon the Hughes and Morse instruments as a preventive measure.

In August 1882 Edmund Robinson,† M.R.C.S., surgeon to the General Post Office at Leeds, read a paper before the British Medical Association upon four cases of telegraphists' cramp. The cases are clearly described, and it is noted that all were workers on the Morse instrument. Mr. Robinson points out the similarity of this complaint to the previously well-recognized cases of writers' cramp. In the same year (1882) a report was made on the subject of telegraphists' cramp by the chief medical officer of the Post Office. Two years later Dr. Fulton,‡ who had been a telegraphist in the Edinburgh Post Office, described§ the disease. Dr. Fulton appears to have had much experience of telegraphists' cramp, which, he stated, was probably more common than was generally supposed. Isolated cases have been reported by observers in several countries, but in 1903¶ an exhaustive monograph on the "occupation neurosis of telegraphists" was published by Dr. E. Cronbach.|| He describes 17 cases which he had observed in Dr. Mendel's hospital in Berlin, and points out that only three of these were Morse workers, while 14 worked on the Hughes instrument. He shows clearly that there is a form of telegraphists' cramp due to continuous working on the Hughes instrument, and argues strongly that substitution of the Hughes instrument for the Morse would have no effect in preventing the occurrence of cramp among telegraphists.

20th December 1910.

H. THEODORE THOMPSON.
JOHN SINCLAIR.

APPENDIX A.

DETAILS OF SIX CASES OF TELEGRAPHISTS' CRAMP SPECIALLY EXAMINED BY
THE SUB-COMMITTEE.

Case 1.—History.—Male, age 39. Learnt telegraphy in the London Telegraph School; was in the school for 14 weeks. Morse operator for 22 years. For the first 20 years no symptoms of any kind; was always considered an efficient operator. Had been selected for special duty on account of his efficiency. Had always been in a busy commercial division, but had not had any special strain before the first appearance of the symptoms. The first symptoms appeared two years ago, when he began to lose flexibility, and telegraphy became such an effort that he continually felt he wanted to rest his arm. No sharp pain, but a dull ache, felt only when keying. No outside worry. No complaint had been made of his work; brought his case under notice himself. Taught himself to key with the left hand after his right became affected, but the same sensation appeared in the left hand after a time; could key, but not so fast.

Health.—Good; absent for 14 days only in 22 years.

Family History.—Good.

Present Condition.—Has not been employed on manipulative work for some time, but is not out of practice. Sending with his right hand now causes serious pain. While sending he grips the key tightly and seems unable to release it, making undue pauses between the words. He holds his knee tightly with his left hand and moves his head, left shoulder, back, and, in fact, his whole body, in unison with his sending. The whole attitude is one of strain and excessive muscular movement.

* Gazette Medicale de Paris, 1875, p. 175.

† British Medical Journal, 1882, November 4th.

‡ T. W. Fulton, M.D., F.R.S.E., Scientific Superintendent of H.M. Fishery Board, Scotland, who has kindly given us permission to quote from his article.

§ Edinburgh Clinical and Pathological Journal, 1884.

¶ Archiv für Psychiatrie, 1903, s. 243.

He has no difficulty in using his hand for any other action than telegraphy; can write, "punch," work with the Gell perforator and Hughes keyboard instrument, and use knife and fork.

Digestive System.—Normal.

Vascular System.—Normal.

Respiratory System.—Normal.

Nervous System.—No tremor, no incoördination, no abnormality in myotatic irritability, no tenderness of nerves, no impairment of sensibility to touch or pain.

Muscles.—No atrophy; small muscles well developed in both hands. Electrical reactions normal to faradism and galvanism: K C C > A C C: by dynamometer right hand = 210, left hand = 200.

Cranial Nerves.—Movement of eyes, tongue, and face normal. State of pupils normal; reaction to light and accommodation good. Optic discs normal.

Case 2.—History.—Male, age 43. Learnt telegraphy in the London Telegraph School; was in the school seven weeks. Morse operator for 28 years, with an interval of six or seven years when he was on counter duty. This occurred after 10 years' service.

He had been employed on busy circuits. He had no special strain before the difficulty commenced, but about four years previously he was employed on a cycle of duties which consisted entirely of keying, and afterwards he had more sending to do than any other kind of work.

Difficulty commenced in 1908, after 26 years' service. He first had a feeling of tiredness and loss of suppleness, followed by difficulty in forming certain letters—q, p, c, v. He had no actual pain until April 1909, when he noticed also that his hand would slip off the key. By June the pain had become so bad that he brought the matter under notice. Anticipation of keying caused uneasiness, and the pain started a few minutes after he commenced work. There was a continuous dull pain, and occasional sharp pains, from his fingers to his shoulder. He even had the pains at night, waking up with them. When his difficulty was brought under notice he was relieved of keying duties; and 10 weeks afterwards all trouble left him and he has had no pains since. It was reported that no complaints had been made as to the quantity or quality of his sending.

Health.—He stated that, apart from his difficulty in manipulation and the consequent anxiety, his health had been good. The official records show an absence of 45 days for influenza in 1907 and eight single days since 1906.

Family History.—Good.

Present Condition.—Stated that he has tried to use his left hand, but he is too old to become expert with it and it soon becomes tired. He has no difficulty in punching, or in writing, even for long periods. He has no difficulty in any other actions besides Morse keying. He has been practising on the Gell perforator, but is not yet expert. He has not learned the Hughes. Is almost a total abstainer. Smokes weekly three to four ounces of light tobacco. He cycles and is fond of photography and fishing.

States that he followed the style of manipulation he had been taught in the school. He did not grip the key or hold it rigidly before the trouble commenced. The gripping of the key at the present time was the result of the spasm. While keying moves arm, shoulder, and head, steadies himself with the left hand on the table or on the left leg. Respires jerkily and breathes in a short, catchy manner; has difficulty in releasing the key.

Digestive System.—Normal.

Vascular System.—Normal.

Respiratory System.—Normal.

Nervous System.—Is rather of a nervous type of man, dark and thin; no headaches, no fits; suffers somewhat from sleeplessness; no tremor, no incoördination, no impairment of sensibility to touch or pain. *Myotatic irritability*—patellar tendon reflex glib; no ankle clonus.

Muscles.—No atrophy. Small muscles well developed in both hands. Electrical reactions normal to faradism and galvanism. By dynamometer, right hand = 115; left hand = 100.

Cranial Nerves.—No abnormality. Optic discs normal.

Case 3.—History.—Male, age 36. Began in 1889 as a telegraphist at the age of 15 in the provinces, where he was employed on the single-needle instrument. He learned the sounder in 1891, and has been a Morse operator for 19 years. He stated that he had no regular instruction, but picked up a knowledge of telegraphy himself as best he could. He was transferred to London in 1894, and he was then said to be "a very free telegraphist." He applied for employment on special news wires in Fleet Street, where he remained until about 1901. He worked from 6 p.m. to 6 a.m. for six days a week, and his duties consisted of sending only. He received extra-duty pay for the long attendance, and an additional bonus if he sent more than a certain quantity of news.

He states that he used to grip the key in order to send firmly. After his difficulty began he tried sending in various ways, varying his style of manipulation.

He first experienced difficulty in sending with his right hand 10 years ago, after nine years of employment on Morse working, and the difficulty has been growing worse for the last seven years. At the commencement his hand was stiff for the first half-hour or so after coming on duty, but the stiffness then passed off and his arm was affected by a dull pain and tired feeling. He first had difficulty in sending the letter C, and the difficulty gradually extended to other letters.

Health.—Pneumonia six years ago. Absent for a week on account of neurasthenia two years ago.

Family History.—Good.

Present Condition.—He now feels a dull pain in his arm as soon as he prepares to begin operating; but he feels no pain, even if he adopts the same attitude, if he is not engaged on manipulative work. Employment on manipulative work causes him to have bad headaches, and interferes with his general health. He performs the action of sending and fancies he hears the sounder in his sleep. His recreation is walking; he does not engage in any other outdoor exercise, and since his trouble he has walked more than before.

His messages on slip are often illegible, but his sending is perfectly readable on the Morse sounder. During the seven years that he has experienced difficulty no complaint as to his sending has been made either by his superintendents or from the offices to which he has worked.

While keying there is excessive action of the hand, forearm, and shoulder. The head also is jerked rhythmically with the arm. He steadies his head by holding his chin with his left hand, his left elbow resting on the table. The position of the hand on the key is fair, but the thumb is jerked off the key at each movement; and there is spasm of the fingers, which refuse to release the key. He has no trouble in writing unless he is writing for a long time.

For the last five years he has used the left hand. He rests the left forearm on the table, and uses either the third or little finger of the left hand to depress the key with a scraping action. Soon after starting, whilst demonstrating his malady, the whole body was affected by spasmodic jerks which shook the table at which he was operating.

He has difficulty in using his left hand for other actions than manipulation, as, for instance, in using a knife and fork or winding up the spring of a Morse printer. On attempting to pick up a pin the left hand becomes rigid, and rapid fine tremor occurs. He was tried for a time on the Hughes, the Gell perforator, and the Yetman instruments, but he had difficulty with his left hand and had to be relieved from the work. He has difficulty in using his left hand whatever operative duties he performs.

Digestive System.—Normal.

Vascular System.—Normal.

Respiratory System.—Normal.

Nervous System.—Well developed; not a nervous type of man; no incoördination; no impairment of sensibility to touch or pain; no tenderness of nerves; sphincters normal. *Myotatic irritability*—patellar tendon reflexes very glib; no ankle clonus.

Muscles.—Very muscular. Tendency to spasm in the left arm on any voluntary effort, but no spasticity. Electrical reactions normal to faradism and galvanism; K C C > A C C. By dynamometer, right hand = 200, left hand = 190.

Cranial nerves.—Normal. Optic discs normal.

Case 4.—History.—Male, age 41. Taught himself telegraphy; did not learn in a school. He was first employed at a railway office, where he worked the Morse instrument. He always had a free style of sending, and never gripped the key. Morse operator for 25 years.

He first began to experience difficulty about 15 years ago, after 12 years' employment on manipulative work.

He found his right arm tire after about half-an-hour's sending, and began to learn to use his left hand. He gradually lost control of his right hand for sending, not over certain letters but generally. Pain was not felt until a later stage. The pain commenced at base of thumb and extended to his neck. He had also pains in the head. Difficulty in writing and keying commenced about the same time. He tried to use his left hand for writing, but was unsuccessful. He had pains in his side as a result of using his left hand. Called attention to his difficulty in writing in July 1909.

Health.—Good.

Family History.—Good.

Present Condition.—Spasm is not pronounced, and there is no marked action of hand, elbow, or shoulder; at times the elbow moves a little; body does not move. He has difficulty in using his right hand for other actions than writing and keying. He has pain and stiffness in "punching"; and he cannot use the Gell, Yetman, and Hughes instruments owing to short fingers. In digging he has lost control of his right hand at times, experiencing a sudden momentary pain, and he then has to stop and rest. Can shave, use knife and fork, &c.

In October last he could not be employed on any instrument, and employment on night circulation duties was suggested. He has been employed on night circulation duties for the last six months.

Drinks about 1 pint of malt liquor daily, and smokes about 3 ounces of a tobacco mixture weekly.

Digestive System.—Normal.

Vascular System.—Normal.

Respiratory System.—Normal.

Nervous System.—No headache; no fits; sleeps well; no incoördination; no impairment of sensibility to touch or pain. Sphincters normal. *Myotatic irritability*—normal.

Muscles.—Well developed in both arms and hands. Electrical reactions normal. By dynamometer, right hand = 160, left hand = 150.

Cranial Nerves.—Normal. Optic discs normal.

Case 5.—History. Male, age 43. Was taught telegraphy in the London Telegraph School, entering at the age of 15; was in the school for three months. Morse operator for 28 years.

He was employed for eight years at the Commercial Sale Rooms, where half his time was occupied with counter duties and half with telegraphy. He was never subjected to special strain, but exerted himself to send as much as possible.

He has had discomfort in sending for about five or six years. It began with loss of control, which was general and not over certain letters. He states that his style was originally free, and that he did not then grip the key. To regain control he gripped the key, and this led to pain. He taught himself to send with his left hand about three years ago to relieve his right hand, but his left hand is now failing as the other one had done. The difficulty with the left hand is not yet so pronounced as with his right hand. The fingers go into spasm and stretch out stiff.

Health.—Good.

Family History.—Good.

Present Condition.—He has stiffness in using his right hand for other actions than keying. He has difficulty in writing, in “punching,” and in using the Hughes instrument. He cannot control the right hand; is unable to change a gas mantle; has spasm before shaking hands; in using a knife, grasps the handle tightly; has difficulty in buttoning his waistcoat.

While keying a spasm of the right hand is seen; the elbow and shoulder move too much. He manipulates the key by tapping with the little finger.

Drinks about one pint of malt liquor daily, and smokes about 1½ ounces of tobacco weekly.

Digestive System.—Normal.

Vascular System.—Normal.

Respiratory System.—Normal.

Nervous System.—Small man of a somewhat nervous type. Sleeps well; no incoördination, no impairment of sensibility to touch or pain. *Myotatic irritability*—normal.

Muscles.—Normal development. Electrical reactions normal. By dynamometer, right hand = 162, left hand = 190.

Cranial Nerves.—Normal. Optic discs normal.

Case 6.—History.—Female, age 27. Learned telegraphy in the London Telegraph School, and was certified to be a qualified telegraphist at the end of her probation in April 1901. She stated that she sent in the approved manner, and did not grip the key.

She first experienced difficulty in keying in 1906 or 1907. She was then employed in a division where there was a great deal of continuous sending. On one occasion she sent as many as 45 or 50 messages in an hour. About six o'clock one day her right hand failed suddenly and she was unable to form letters. She then took to using her left hand to relieve her right hand.

About six months later she began to have difficulty in writing also.

In December 1907 her difficulty in writing was brought under notice by the medical officer, and exemption from duties involving continuous writing was given for three months. It was not known officially that she had any difficulty in sending.

In June 1908 she was understood to have recovered; but she now states that the recovery was not complete, and that she continued to have some little pain and stiffness in her arm. She was then employed in a division where sending and receiving duties were about equal, and where duty at the intercommunication switch afforded relief from sending. In October 1909 her former difficulty was said no longer to exist.

She has since been employed in another division until about a fortnight ago; and she states that the return to a full day's manipulative work (half sending, half receiving) has led to a recurrence of the difficulty.

Health.—Good.

Family History.—Good.

Present Condition.—Sending now causes pain in the hand and forearm starting from the thumb, and if sending is persisted in it causes tremor. She experiences the pain in other actions besides keying—in writing, in using a needle or a knife and fork.

Digestive System.—Normal.

Vascular System.—Normal.

Respiratory System.—Normal.

Nervous System.—No incoördination, no impairment of sensibility to touch or pain. *Myotatic irritability*—normal.

Muscles.—Normal development. Electrical reactions normal. By dynamometer, right hand = 60, left hand = 75.

Cranial Nerves.—Normal. Optic discs normal.

APPENDIX B.

COPY of circular sent to Telegraphists employed in the Central Telegraph Office and in large provincial offices with a separate telegraph staff.

M

A Committee is at present sitting to enquire into the prevalence and causes of the disease known as 'Telegraphists' Cramp' and to report what means may be adopted for its prevention.

Although satisfied that the great majority of the staff is quite free from this trouble, this Committee feels it to be very important in the interests of the operators themselves that the actual number of persons, male and female, who feel, whilst keying, any symptoms, even though not severe, of pain, loss of control over the instrument, or other difficulty in sending, should be known.

It is earnestly requested that you will be good enough to assist the Committee by answering the enclosed list of questions with care and absolute accuracy, and handing the form *immediately* to your Superintendent sealed in the accompanying envelope.

The form need not be signed if you specially wish that your name should not be known; nor is it essential that the answers should be in your own handwriting. The sole object of the Committee is the compilation of careful statistics.

S. A. PATERSON,

28th April, 1910.

Secretary to the Telegraphists' Cramp Committee.

OFFICE, _____

(* _____ Staff).

1. Age in years
2. Particulars of service with dates
3. How long have you been using the Morse key?
4. Did you receive regular instruction? or did you teach yourself as best you could?
5. Can you use either hand in sending? If so, why did you learn to use your second hand?
- †6. How many hours are you generally employed per day in—
 - (a) up and down work?
 - (b) sending?
 - (c) receiving?
7. Have you ever felt, whilst keying—
 - (a) pain
 - (b) loss of control over your instrument
 - (c) any other difficulty in sending

If so, state when and in what circumstances the symptoms commenced, and describe them as clearly as you can
8. Have you any explanation of your own of these symptoms (*e.g.* fatigue, rheumatism, indifferent health, &c.)?

9. Have the symptoms continued the same to the present time? or have they ceased or altered their character? and do you always experience them whilst keying?
10. Do you have any similar difficulty in doing other things besides keying, such as writing, using knife and fork, needle, &c.?

Signature _____

Date _____

* Insert "male" or "female" as the case may be.

† If you are employed on rotating duties give these particulars in respect of the week ended Saturday last.

APPENDIX C.

RESULT of personal examination of 148 Telegraphists (all who were available) of the "F" Division of the Central Telegraph Office.

Number of Telegraphists examined who had difficulty in Keying.			Number of Telegraphists examined who had no difficulty in Keying.
Difficulty due to "Cramp."	Difficulty due to "early subjective stage of Cramp."	Difficulty due to "fatigue or other causes."	
7	6	80	55

Note.—None of the Telegraphists who had difficulty in keying was disabled from performing his allotted duty.

APPENDIX D.

ANALYSIS of the replies to the Circular (Appendix B) (excluding those from the "F" Division of the Central Telegraph Office).

	Complaints of "difficulty" in Keying.						No Complaints.		Total.
	Complaints suggesting "Cramp."		Complaints suggesting early subjective stage of Cramp.		Complaints suggesting muscular fatigue or other causes of difficulty.				
	Number.	Percentage.	Number.	Percentage.	Number.	Percentage.	Number.	Percentage.	
Forms signed - Men	177	4·8	41	1·1	1,060	28·8	2,406	65·3	3,684
Forms signed - Women	42	2·4	15	0·8	420	23·8	1,291	73·0	1,768
Forms unsigned - Men	68	9·5	11	1·5	406	56·5	234	32·5	719
Forms unsigned - Women	26	2·6	24	2·4	474	47·9	467	47·1	991
Total - Men	245	5·6	52	1·2	1,466	33·3	2,640	59·9	4,403
Total - Women	68	2·5	39	1·4	894	32·4	1,758	63·7	2,759
Grand Total -	313	4·4	91	1·3	2,360	32·9	4,398	61·4	7,162

APPENDIX E.

STATEMENT showing, in respect of Telegraphists affected with Cramp in early or developed stages, the length of service involving use of Morse key which they had had when difficulty was said to have been first experienced.

Service in Years.	Males.			Females.			Total Male and Female.
	Signed.	Unsigned.	Total.	Signed.	Unsigned.	Total.	
1	1	2	3	1	—	1	4
2	2	3	5	2	—	2	7
3	2	2	4	4	3	7	11
4	3	1	4	6	1	7	11
5	6	—	6	1	2	3	9
6	4	3	7	4	2	6	13
7	4	2	6	3	2	5	11
8	5	—	5	1	3	4	9
9	6	2	8	—	3	3	11
10	9	4	13	1	4	5	18
11	9	2	11	1	1	2	13
12	7	4	11	—	2	2	13
13	4	2	6	—	—	—	6
14	4	2	6	2	1	3	9
15	7	1	8	1	—	1	9
16	10	3	13	1	1	2	15
17	3	3	6	—	1	1	7
18	5	2	7	—	—	—	7
19	8	3	11	1	1	2	13
20	12	2	14	—	—	—	14
21	4	—	4	—	1	1	5
22	7	1	8	—	—	—	8
23	3	—	3	—	—	—	3
24	3	1	4	—	—	—	4
25	3	1	4	—	—	—	4
26	1	1	2	—	—	—	2
27	1	—	1	—	—	—	1
28	—	—	—	—	—	—	—
29	1	—	1	—	—	—	1
30	1	—	1	—	—	—	1
31	—	—	—	—	—	—	—
32	1	—	1	—	—	—	1
33	—	1	1	—	—	—	1
34	—	—	—	—	—	—	—
35	1	—	1	—	—	—	1
36	1	—	1	—	—	—	1
	138	48	186	29	28	57	243

Note.—In 174 replies this information was not given.

APPENDIX F.

AMBIDEXTERITY AMONGST CRAMP SUBJECTS.

	Number of Cramp Subjects Ambidextrous.												Number of Cramp Subjects not Ambidextrous.			Not stated whether Ambidextrous or not.	Total.
	Ambidextrous before developing Cramp.			Second Hand used when first Cramped.			Reason for use of Second Hand not stated.			Total Number Ambidextrous.			Signed.	Unsigned.	Total.		
	Signed.	Unsigned.	Total.	Signed.	Unsigned.	Total.	Signed.	Unsigned.	Total.	Signed.	Unsigned.	Total.					
Male	24	9	33	129	48	177	12	4	16	165	61	226	65	19	84	—	310
Female	2	4	6	35	26	61	1	4	5	38	34	72	17	16	33	2	107
Total	26	13	39	164	74	238	13	8	21	203	95	298	82	35	117	2	417

APPENDIX G.

STATEMENT of the Number of Telegraphists affected with Cramp in early or developed stages who had received regular instruction in Telegraphy.

	Regular Instruction.			No Regular Instruction.			Information not given.	Total.
	Signed.	Unsigned.	Total.	Signed.	Unsigned.	Total.		
Males - - -	149	62	211	80	19	99	—	310
Females - - -	41	41	82	14	9	23	2	107
Total - - -	190	103	293	94	28	122	2	417

APPENDIX H.

COMPLAINTS regarding Morse Keys, and Preferences expressed by Telegraphists affected with Cramp.

Complaints.				Preferences.		
Keys, Heavy and Stiff.	Lack of Uniformity in Adjustment.	Difficulty felt only on Light Keys.	Difficulty felt only on S.C. Keys.	D.C. Keys.	S.C. Keys.	Single Needle and Double Plate Sounder Instruments.
378	136	8	23	23	7	3

APPENDIX I.

COMPARATIVE STATEMENT of the Number of Movements made per Minute by Typists and Telegraphists.

	Typists.				Telegraphists.			
	Words per Minute.	Movements per Minute.			Words per Minute.	Movements per Minute (approximate).		
		Flexor Contractions.	Extensor Contractions.	Total.		Flexor Contractions.	Extensor Contractions.	Total.
Speed work of good operator.	50	250	250	500	40	510	510	1,020
Sustained work of good operator.	35	175	175	350	30	383	383	766
Sustained work of average operator.	25	125	125	250	20	255	255	510

APPENDIX No. 2.

List of Witnesses examined by the Committee.

- Mr. L. D. Barclay, Assistant Superintendent, Class II., Central Telegraph Office, in charge of School.
- Mr. F. Benson, Assistant Superintendent, Class II., Central Telegraph Office.
- Mr. S. J. Ching, Deputy Staff Officer, Secretary's Office.
- Mr. A. S. Coates, Assistant Controller, Central Telegraph Office.
- Miss L. A. Cooke, Telegraphist, Central Telegraph Office, Instructress in School.
- Mr. A. E. Eames, Controller, Central Telegraph Office.
- Mr. F. H. S. Grant, Second Class Clerk (Grade I), Secretary's Office.
- Mr. E. L. Hilton, Assistant Superintendent, Class II., Central Telegraph Office.
- Miss G. S. Lynch, Supervisor, Central Telegraph Office.
- Miss M. L. C. Madgshon, M.B. Lond., Female Medical Officer.
- Mr. C. E. Mulholland, Executive Committee, Postal Telegraph Clerks' Association.
- Mr. J. Newlands, C.I.E., Controller, Central Telegraph Office.
- Mr. C. C. Sanderson, Postmaster, Leeds.
- Mr. W. T. Smith, Telegraph Traffic Manager.
- Mr. C. Surmun, Chief Telegraph Superintendent, Liverpool.
- Mr. E. R. Tuck, General Secretary, Postal Telegraph Clerks' Association.
- Mr. S. W. Turpin, Telegraphist, Central Telegraph Office.
- Mr. J. Willshire, Assistant Controller, Central Telegraph Office.
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APPENDIX No. 3.

**Reports from Telegraph Administrations of Austria,
Belgium, France, Germany and Italy; and from
Mr. Newlands about India.**

A letter in the following terms was sent to the Telegraph Administrations of Austria, Belgium, France, Germany, and Italy:—

Sir,

I am directed by the Postmaster-General to state that he is making enquiries into the cause and prevalence of the disease known as telegraphists' cramp, to which officers employed in sending messages with the Morse telegraph key are liable, with a view to finding means of prevention; and if there has been any experience of the disease in _____ he would be greatly obliged if Your Excellency would be so good as to furnish him with any available information on the following points:—

- (1) The percentage of telegraphists employed in sending messages with the Morse telegraph key who have been found to suffer from telegraphists' cramp:
- (2) Whether the use of any telegraph instrument other than the Morse key has been found to cause any disease analogous to telegraphists' cramp:
- (3) What preventive measures, if any, have been taken in respect of telegraphists' cramp:
- (4) What arrangements, if any, are made for the instruction of learners in telegraph manipulation:
- (5) What rate of working is expected from an expert Morse telegraphist.

If Your Excellency has any other information which would be likely to assist the enquiries the Postmaster-General is making, he would be glad to be supplied with it.

The Postmaster-General would esteem it a favour if the information could be supplied at an early date.

I am, &c.

Mr. Newlands was also asked for a similar report about India.

The following replies have been received:—

TRANSLATION.

Vienna, 12th May 1910.

To the Secretary, General Post Office, London,

In answer to your communication of the 30th of April last, I have the honour to inform you that the appearance of telegraphists' cramp amongst the staff employed in working the Morse apparatus has not up to the present come under notice here. Telegraphists, of course, show signs of fatigue after several hours continuous working, both with the Morse as well as with the Hughes apparatus, but this is not regarded specially as cramp.

For ease of operating, the key in sounder working is not fixed immediately at the front edge of the apparatus table, but 40 cm. (15½ inches) back, so that the operator may have a support for his arm. In addition, the keys generally are adjusted for a small amount of play.

In the course of instruction in Hughes manipulation, care is taken that learners acquire a practical fingering, so as to avoid certain strained positions of the fingers.

The average rate of working of a skilled telegraphist on Morse apparatus amounts to 500 words an hour (six letters to the word).

For the Imperial and Royal Minister of Commerce,

(Signed) WAGNER.

H 4

TRANSLATION.

Brussels, 2nd July 1910.

To the Postmaster-General, General Post Office, London,

I have the honour to forward herewith the information asked for in your letter of the 30th of April last.

* * * * *

For the Direction General,
(Signed) J. BANNEUX.

ENCLOSURE TO REPLY FROM BRUSSELS.

(1) The percentage of telegraphists employed in sending messages with the Morse telegraph key who have been found to suffer from telegraphists' cramp.

Answer.—The number of authenticated cases of cramp among Belgian telegraphists is comparatively small, and there are at the present time only a few officers—10 at the most, out of a staff of more than 1,900 officers—who suffer from this affection.

This satisfactory position is due, no doubt, to the fact that officers are rarely required in Belgium to work continuously and at high pressure in the manipulation of Morse apparatus.

Heavy circuits are worked by means of the Hughes apparatus, and at other circuits messages are received and sent alternately.

In addition, in consequence of a system of direct transmission of telegrams to their destination, and the participation of officers of the railway, postal and other services in the performance of the work, the rate of working is not generally high.

(2) Whether the use of any telegraph instrument other than the Morse key has been found to cause any disease analogous to telegraphists' cramp?

Answer.—It has not been determined that any apparatus other than the Morse has caused any affection whatever analogous to telegraphists' cramp.

Officers suffering from this affection can work the Hughes apparatus without difficulty.

(3) What preventive measures, if any, have been taken in respect of telegraphists' cramp?

Answer.—Although cases of cramp are exceptional in its service, the Belgian telegraph administration has been led to take certain measures to facilitate Morse working which will probably tend to prevent this affection. (*See on this point the answer to question 4.*)

For the rest, officers of a nervous temperament and consequently predisposed to cramp, as well as those who are already more or less affected with cramp, are recommended to keep a watch upon their style of sending and especially to send more slowly. If necessary they are relieved temporarily from Morse working and employed on writing and other duties.

Total abstention from manipulation is the chief means of cure in cases of the kind, a female officer affected with cramp underwent electric treatment accompanied with massage with good results.

(4) What arrangements, if any, are made for the instruction of learners in telegraph manipulation?

Answer.—The Belgian Administration has taken the following measures:—

(1) A light and easily worked key, called "American," is used. The play of the lever is very small, so as to require only a minimum expenditure of energy on the part of the operator.

(2) The learner is watched to see that in making the signals he does not cramp the fingers nervously or grip the knob of the key too firmly.

(3) Sending and receiving are practised alternately; if the learner shows the least fatigue, the work is suspended; besides, the time devoted to instruction in the rules and regulations affords in any case intervals of rest for the hand.

(4) It is forbidden to send with the hand resting on the table, this method of working causing too much fatigue to the nerves which control the fingers and forearm.

(5) Learners are required to learn to send with the left hand as well as to learn to send with the right hand.

At the present time, however, ambidextrous instruction has only been carried out to a limited extent. The result of experience will show if it is desirable to extend it, and whether it would not even be preferable for sending to be performed entirely with the left hand, the right hand being used exclusively for transcription. So far as this is concerned, it must be recognized that it is somewhat irrational to impose all the work on the right hand; it would seem more logical to divide the work between the two hands.

The objections which have hitherto been raised against the use of the left hand for manipulating the Morse key have not been borne out by the facts. Some officers affected with cramp and unable to send with the right hand are now performing their duties quite well with the other hand. Besides, in comparatively important offices, officers send telegrams readily with both hands.

In any case, ambidexterity gives officers an opportunity of relieving the right hand if this becomes too tired.

(5) What rate of working is expected from an expert Morse telegraphist?

Answer.—Under normal conditions of Morse working, as this is practised in Belgium, a telegraphist being in communication successively with different offices, the rate of working of an expert telegraphist is, on an average, 20 telegrams of 15 words per hour, including the time occupied by repetitions and preliminaries. This rate is easily increased to 25 telegrams if the traffic is steady.

When messages are sent between the same two offices, the normal rate is 30 telegrams an hour, and may reach even 40 to 50 if there is exceptional pressure; but Belgian telegraphists are rarely required to exert themselves to this extent, circuits where the traffic is sufficiently heavy being generally worked with the Hughes apparatus.

TRANSLATION.

Paris, 13th June 1910.

The Secretary,

You have asked for information respecting the experience which has been had in France of the disease known as telegraphists' cramp, what preventive measures have been taken with regard to it, particularly for the instruction of learners, and lastly, what rate of working the French Administration expects of an expert Morse telegraphist.

I have the honour to inform you that cases of telegraphists' cramp have never been of sufficiently frequent occurrence among French Morse operators for the Administration to think it necessary to trouble about it or to consider special preventive measures apart from the general rules which apply to good manipulation.

In special cases which have come under notice, the Administration has not done more than find other work for officers whose nervous condition has rendered them unsuitable for Morse manipulation.

The instruction of learners is effected partly in special schools, partly in the telegraph offices under the direction and supervision of experienced officers.

The French Administration recognizes that schools are the better arrangement for the systematic instruction of learners.

With regard to the hourly rate of Morse or sounder working, the Administration estimates the average at 25 messages, if the work is continuous.

For the Minister of Public Works, Posts and Telegraphs.

The Director of Telegraphs,

(Signed) J. BORDELONGUE.

[In reply to a further enquiry it was stated that the average number of words in inland telegrams is 14.]

TRANSLATION.

Berlin, 22nd June 1910.

To the General Post Office, London,

To the enquiries of the 30th of April from the General Post Office respecting the experience which has been had of the so-called telegraphists' cramp, I have the honour to reply as follows:—

(1) So far as this Administration is concerned, this disease has rarely or never been met with. Morse and sounder instruments are here used only for minor traffic; the heavier traffic is dealt with mainly with Hughes and fast automatic apparatus.

TRANSLATION.

Brussels, 2nd July 1910.

To the Postmaster-General, General Post Office, London,

I have the honour to forward herewith the information asked for in your letter of the 30th of April last.

* * * * *

For the Direction General,
(Signed) J. BANNEUX.

ENCLOSURE TO REPLY FROM BRUSSELS.

(1) The percentage of telegraphists employed in sending messages with the Morse telegraph key who have been found to suffer from telegraphists' cramp.

Answer.—The number of authenticated cases of cramp among Belgian telegraphists is comparatively small, and there are at the present time only a few officers—10 at the most, out of a staff of more than 1,900 officers—who suffer from this affection.

This satisfactory position is due, no doubt, to the fact that officers are rarely required in Belgium to work continuously and at high pressure in the manipulation of Morse apparatus.

Heavy circuits are worked by means of the Hughes apparatus, and at other circuits messages are received and sent alternately.

In addition, in consequence of a system of direct transmission of telegrams to their destination, and the participation of officers of the railway, postal and other services in the performance of the work, the rate of working is not generally high.

(2) Whether the use of any telegraph instrument other than the Morse key has been found to cause any disease analogous to telegraphists' cramp?

Answer.—It has not been determined that any apparatus other than the Morse has caused any affection whatever analogous to telegraphists' cramp.

Officers suffering from this affection can work the Hughes apparatus without difficulty.

(3) What preventive measures, if any, have been taken in respect of telegraphists' cramp?

Answer.—Although cases of cramp are exceptional in its service, the Belgian telegraph administration has been led to take certain measures to facilitate Morse working which will probably tend to prevent this affection. (*See on this point the answer to question 4.*)

For the rest, officers of a nervous temperament and consequently predisposed to cramp, as well as those who are already more or less affected with cramp, are recommended to keep a watch upon their style of sending and especially to send more slowly. If necessary they are relieved temporarily from Morse working and employed on writing and other duties.

Total abstention from manipulation is the chief means of cure in cases of the kind, a female officer affected with cramp underwent electric treatment accompanied with massage with good results.

(4) What arrangements, if any, are made for the instruction of learners in telegraph manipulation?

Answer.—The Belgian Administration has taken the following measures:—

(1) A light and easily worked key, called "American," is used. The play of the lever is very small, so as to require only a minimum expenditure of energy on the part of the operator.

(2) The learner is watched to see that in making the signals he does not cramp the fingers nervously or grip the knob of the key too firmly.

(3) Sending and receiving are practised alternately; if the learner shows the least fatigue, the work is suspended; besides, the time devoted to instruction in the rules and regulations affords in any case intervals of rest for the hand.

(4) It is forbidden to send with the hand resting on the table, this method of working causing too much fatigue to the nerves which control the fingers and forearm.

(5) Learners are required to learn to send with the left hand as well as to learn to send with the right hand.

keys were flat on the top, and they had sharp edges. I caused straight bar keys to be introduced bearing rounded knobs of a larger size, such as I had been advocating in this country for many years past; and all the keys were compulsorily removed to the more natural right-handed position, leaving the arm free.

The Indian telegraphists are chiefly composed of Eurasians and Natives, with an admixture of military signallers from the British Army. I should say that all the conditions were such as might be expected sooner or later to produce cramp or muscular tiredness, considering the poor physique of the staff and the quality and fixture of the apparatus. In fact, cramp was in its incipient stage in many cases. But the total amount of telegraphing was not great, and the average speed of working was excessively low. Then again, all the principal circuits where there was a reasonable volume of business to be disposed of were extremely long, ranging from 800 to 1,100 miles in length, and this undoubtedly tended towards reducing the rate of signalling. The conditions were therefore special, and different altogether from what is common in the United Kingdom. Moreover, as the staff was far in excess of the actual requirements, the work done by most of the staff was of a very light character.

(2) With the exception of a very few Wheatstone and Baudot sets of apparatus and one "Murray," the use of the Morse key and sounder was universal.

* * * * *

(4) In India the training was somewhat primitive, the apparatus was poor as a rule, and the teachers were occasionally either too old or they had themselves acquired a defective style. Moreover, schools only existed in the largest centres.

(5) On the principal circuits in India the rate of signalling was in most cases good, as good indeed as anything we have in the United Kingdom, but this was due to the payment of a rate per message after a fixed number had been disposed of. I found numerous instances where 40, 50, and 55 messages per hour had been dealt with, but in view of the abnormally long wires and overloaded circuits containing too many offices joined together, it was impracticable to obtain such high general averages as are common in this country, consequently I fixed a lower limit.

6th June 1910.

(Signed) J. NEWLANDS.

PRINCIPAL TELEGRAPH SYSTEMS in use in various COUNTRIES of EUROPE and in INDIA,
1907, extracted from the GENERAL TELEGRAPH STATISTICS issued by the
INTERNATIONAL TELEGRAPH UNION.

Systems.	Austria.	Belgium.	France.	Germany.	Great Britain and Ireland.	India.	Italy.
Morse (printers and sounders).	6,047	2,749	14,416	16,059	10,155	12,512	7,642
Wheatstone - -	—	—	6	13	516	—	113
Hughes - - -	363	99	899	1,174	111	—	309
Baudot - - -	4	—	292	7	3	—	25
A.B.C. - - -	—	—	247	—	4,171	—	—
Single needle - -	—	—	—	—	860	—	—
Telewriters - -	—	—	—	284	—	—	—

APPENDIX No. 4.

Report by Mr. Purves on Telegraphists' Cramp in the United States.

For the Committee,

During a recent visit to America I endeavoured to gather some information regarding the prevalence of telegraphists' cramp among the operators of the public telegraph companies of the United States, and the general operating conditions bearing on the subject. The National Post Office does not include a Telegraph Department: the whole internal telegraph business of the country, apart from the private work of railway companies and of numerous commercial establishments which transmit their own telegrams over leased lines, is in the hands of two large competing companies, the "Western Union Telegraph Company" and the "Postal Telegraph Company." These companies together employ about 35,000 male and 5,000 female telegraphists. The Postal Company's system is confined to the service of the larger towns. Both companies are privately owned and conducted. As public service corporations they are subject to a certain amount of State supervision on the part of "public service commissions," but this supervision is practically restricted to the rates charged for the service and does not appear to have at any time involved interference with the conditions of employment of the personnel. The operating staff at the various offices is not placed upon a permanent basis of establishment as in the British Post Office telegraph service, and the average period for which a telegraphist is employed at any office is comparatively short. Additional operators are engaged, or the force is reduced by discharges, according to the requirements of the service for the time being. Remuneration does not depend upon length of service, but is based simply upon the quality of the work which an individual is capable of doing. There is always plenty of demand somewhere for skilled telegraphists and they move about from place to place very freely. Many operators seem to make a point of introducing as much variety as possible into their lives by frequent changes; indeed, some of the more adventurous spirits make a regular practice of consulting their comfort by moving southwards for the winter and coming northwards into cooler latitudes in summer, in each case taking the chance of finding employment in the localities where they seek it.

Such conditions do not favour the accumulation of definite statistics with regard to such matters as telegraphists' cramp, and it is not surprising that the amount of helpful information available is but slight. There has been no general study of the subject from a medical standpoint, and neither company has ever instituted any systematic inspection of men affected. It is therefore impossible to say what proportionate number of cases observed has been due to the occurrence of true cramp as distinguished from breakdown due to muscular or nervous fatigue. All are referred to in general terms as "cramp" or "loss of grip." Even on this basis there are no regular statistics available, and an idea of the prevalence of the affection can only be obtained by consulting experienced officials of the companies.

The controlling officers of both companies gave the utmost possible assistance by directing my enquiries into quarters where the most reliable information was likely to be found, and by collecting the opinions of their supervising staff upon various points as far as practicable.

The proportion of operators showing symptoms of cramp is stated by the Western Union Company to be 4 per cent., and the Postal Company place the figure at about 10 per cent. The percentage of males and females affected is approximately equal. The symptoms usually become evident after about five years' service; they affect the arm, wrist, and fingers, and generally develop slowly, accompanied by increasing cramping of the muscles and pain in manipulation. Cases of cramp are noticeably more frequent on fast working wires than on the more moderate wires, but it is thought that physical predisposition rather than overwork is the primary cause.

There is no record of any bad case of cramp having been permanently cured, but instances have been known where a change to other work for a few months has "restored the grip" in incipient cases.

The following particulars were furnished regarding the output of operators' work :—

	Western Union Company.	Postal Company.
Number of messages sent and received by each operator in a day at principal offices :—		
Average of all wires - - - - -	150	—
Average on main trunk wires - - - - -	300	—
Ordinary circuits, average - - - - -	—	200 to 300
" Bonus " circuits, average - - - - -	—	400 to 600
Average speed in words per minute - - - - -	20	15 to 30
Average number of words per message - - - - -	32	30
Average number of letters per word - - - - -	5 or 6	5

The highest number of messages sent and received by an operator in a day, quoted by the Postal Company, refers, as indicated, to important circuits on which a bonus is paid for rapid working.

Since returning to this country I have been in correspondence with the officials of the Postal Telegraph Company regarding the maximum daily output of work per operator, and have been furnished with the following return showing the total number of messages handled each day during the month of April 1911—Sundays excepted—between the hours of 8 a.m. and 5.30 p.m. on four important "bonus" circuits. It is stated that the work done during the half hour when the operator in charge of the circuit was at lunch has not in any case been included in the total.

Entire Month of April from 1st to 30th, 1911.

Number of messages handled between 8 a.m. and 5.30 p.m. :—

	Buffalo, N.Y.	E. Chicago.	X Boston Overflow Circuit.	X Philadelphia.
	Sent. Received.	Sent. Received.	Sent. Received.	Sent. Received.
1st	313 317	465 522	200 125	446 488
2nd	Sunday	Sunday	Sunday	Sunday
3rd	255 360	520 564	262 189	501 592
4th	312 400	511 445	248 214	557 675
5th	438 537	686 539	400 343	772 770
6th	544 449	668 513	454 459	530 692
7th	493 506	486 539	287 181	518 609
8th	486 413	481 466	189 267	428 462
9th	Sunday	Sunday	Sunday	Sunday
10th	438 475	520 554	600 644	568 597
11th	548 481	503 522	223 138	542 615
12th	519 523	495 543	355 349	534 601
13th	525 507	376 215	203 429	569 668
14th	550 489	598 423	223 451	320 203
15th	460 453	513 524	262 337	480 598
16th	Sunday	Sunday	Sunday	Sunday
17th	566 468	565 554	393 219	559 450
18th	502 415	520 554	287 209	483 597
19th	578 477	547 559	89 4	501 496
20th	503 433	555 488	312 347	480 524
21st	531 401	524 469	100 127	417 552
22nd	496 277	640 400	117 100	440 445
23rd	Sunday	Sunday	Sunday	Sunday
24th	431 435	421 344	345 303	597 600
25th	457 302	475 417	130 148	518 538
26th	236 365	552 521	373 332	572 496
27th	182 249	532 530	266 239	562 573
28th	171 400	609 567	168 200	579 601
29th	245 312	529 531	363 457	707 528
30th	Sunday	Sunday	Sunday	Sunday

It will be noticed that on three occasions the daily output of an operator exceeded 700 messages, on 14 occasions it was between 600 and 700, and on 68 occasions it was between 500 and 600. The return may be summarised as follows:—

Circuit.	Busiest Day.		Average for Month.	
	Total.	Hourly Average.	Daily.	Hourly.
New York to Buffalo—sent - - - - -	578	64·2	431·16	47·9
Do. —received - - - - -	537	59·6	417·76	46·4
New York to Boston—sent - - - - -	600	66·6	273·96	30·4
Do. —received - - - - -	644	71·5	272·44	30·2
(Circuit used for overflow only.)				
New York to Chicago—sent - - - - -	686	76·2	531·64	59
Do. —received - - - - -	567	63	492·12	51·7
New York to Philadelphia—sent - - - - -	772	85·7	527·20	58·6
Do. —received - - - - -	770	85·5	558·80	62

Each of the wires in question is a hand-worked duplex Morse circuit, operated either by an ordinary Morse key or by a "Vibroplex" key at the will of the sending telegraphist. It was stated that traffic during the month covered by the return was somewhat below the normal; in response to an enquiry as to whether operators could maintain such high speeds of working without injury, the Superintendent of Traffic replied as follows:—"Bonus operators, as a rule, stand the strain without serious results. An occasional short leave of absence seems to keep those of a nervous temperament in proper working condition. We seldom have to assign them to less strenuous duty."

Mr. A. S. Hibbard, of the American Telephone and Telegraph Company and Western Union Company, who is at present in England, kindly ascertained by cable that the hourly average of all operators in the New York Head Office of the Western Union Company during the entire month of May 1911 was 18·54 messages. This average includes the whole of the night and also Sundays and holidays. The highest number of messages handled during May by a single operator in a day of nine working hours was 452, the hourly totals being as below:—

37
41
70
65
16—half hour (lunch).
51
65
37
45
25—half hour.

—
452
—

It may be mentioned that the output in messages per hour, with a given length of message and at a given speed of sending in words per minute, is greater in America than in England on account of the fact that the sending operators are generally trained to time and initial the messages with the left hand, and are thus able to work straight on without any intervals between messages. This condition calls for very expert receiving at the other end of the line, and in this connection the general use of typewriters, referred to later, is a factor of importance. The additional speed of typing as compared with writing in manuscript enables the receiving operator to deal with the timing, &c., of the successive message forms while retaining the commencing particulars of the next message in mind, and afterwards to overtake the sender much more rapidly than would be possible by manuscript work.

The period of duty exclusive of meal relief is nine hours for day work and 7½ hours for night work.

There is no fixed limit to the time an operator may be engaged in continuous sending on a duplex wire. The matter is left to mutual agreement between the sending and receiving operators: sometimes half a day is spent on each class of duty, but more frequently the operators interchange at two-hourly intervals.

The average pay of operators in the Western Union Company is 66 dollars a month for males and 50 dollars for females, the actual remuneration in each case being based on the ability and experience of the operator and the amount of work he or she is capable of doing. In the Postal Company operators are graded into three classes according to ability, and their remuneration ranges from 40 to 95 dollars a month.

Operators are not entitled to any leave, but usually arrange to take an annual vacation of one or two weeks without pay.

All floor supervisors are practical telegraphists, and it is their duty to see that a proper output of work is maintained by each operator. At all the principal offices a record is kept at the circuit to show the work done each hour by every individual operator. These records form the basis according to which operators are graded and remunerated, and supervisors are required to watch their operators' records to see that the amount of work done is satisfactory for the circuits to which they are assigned. In the Postal Company the hourly averages per operator for all offices are scrutinised and recorded at headquarters, but in the Western Union Company the returns are only centralised in districts. In both Companies, however, a periodical statement showing average operating cost per message at each office is used at headquarters as a means of comparing the relative efficiency of the various offices.

The Morse signalling keys used throughout America are of the lightly constructed "closed circuit" form, having hard metal contacts and shallow dished finger knobs, with which the Committee are already familiar. The keys are planted about a foot from the edge of the table instead of close to the edge as in England. The operators invariably rest the forearm on the table when signalling, and the points of the first two fingers are generally used to depress the key, a little assistance being given by side pressure of the thumb on the edge of the knob. Young operators are taught to rest the forearm on the table and to hold the key in the manner mentioned, but neither Company maintains any operators' school, and the instruction given does not appear to be at all systematic. Operators are expected to have attained a fair degree of skill before applying for employment.

There is no standard regulation of the amount of play of the key levers or of the pressure required to work them, but the keys are readily adjustable in both respects, and individual operators adjust them to suit their own convenience. There are no types of soft contact or spring contact keys in use. Variations in the size and shape of the finger knobs have been tried experimentally, and knobs made of soft rubber have also been tried, but the result has not been such as to justify any departure from the standard form of key, which continues to be fitted on all manually operated circuits.

Telegraphists who experience difficulty in sending on the ordinary keys are allowed to provide themselves with special keys at their own expense. An adjustable drop handle form of key known as the "20th century key" was observed to be used by a few operators in the Postal Company's offices. This key is said by those who use it to afford a considerable measure of relief from the strain of sending, but it does not appear to be making much progress towards general popularity, although it has been freely advertised for several years. The great majority of operators who have become affected by cramp, or who experience any difficulty in sending on the ordinary keys, resort to the use of semi-automatic keys—"Vibroplex," "Autodot," "Mecograph," &c. Many forms of these keys are on the market and some of them have been already inspected by the Committee. The proportion of operators using semi-automatic keys is given by the Postal Company as 10 per cent. and by the Western Union Company as 6 per cent.; but the latter Company states that such keys are used by quite 50 per cent. of the operators who work the private wires leased by the Company to the public. The keys are in all cases the personal property of the operators who use them. They can be readily connected by means of a two-way plug and cord to the circuit closing switch of the permanent key on any circuit. I may mention that the "closed circuit" system of telegraph working, which is still general in America, does not necessitate the use of keys having more than a single contact. The keys used in England and elsewhere, even on the simplest circuits, have front and back contacts; and semi-automatic keys adapted for similar conditions would require to be more complex than those used in America. Further, the English keys and system of connections would not permit of the ready attachment and disconnection of an auxiliary semi-automatic key. Another point which favours the use of these keys in America is that the closed circuit system of working

incidentally enables the operator to hear, on his own sounder, all the signals he is sending. This is of no advantage in ordinary Morse key working, but it provides a method of guidance without which the proper manipulation of a semi-automatic key would probably be quite impracticable.

The Western Union Company raises no objection to the use of semi-automatic keys by its operators provided proper judgment is used, but the Postal Company views them with much disfavour. The Vice-President of the latter Company gave me a copy of an article on the subject which appeared in the Company's Journal, "The Postal Telegraph," of February last, and of a letter which he is circulating to all the Company's managers. The article and circular letter are reproduced below.

THE EFFECT OF SENDING MACHINES UPON QUADRUPLICES. BY J. P. O'DONOHUE.

During a series of quadruplex experiments recently made in our laboratory, the detrimental effects of high speeds of polar reversals upon the common side margin were clearly brought out. The results of these tests will no doubt be of interest to all chiefs and operators at this time owing to the now general use of sending machines.

Upon an artificial line representing 600 miles of No. 9 copper overhead construction, using standard sets and voltages, it was found that, when the polar side was operated at a rate of 15 words per minute, the common side was capable of a speed of 40 words a minute. Increasing the polar speed to 30 words a minute greatly reduced the common side margin and lowered the working speed to 20 words. Operating the polar at 45 words cut the common to 15 words, and running up the polar to 60 words rendered the common side practically useless at any speed. Automatic sending devices were employed during these tests, so as to obtain uniform signals under all speed conditions.

Now here is where the sending machine comes in. These sending machines are very often so adjusted that the dots are made at the rate of 50 words a minute *while the actual speed made by the operator is only 30 words a minute.* When the machines are used on polar sides of quads., the common sides suffer a serious reduction in working margin due to the high speed dot reversals on the polar side, and consequently the total carrying capacity of the quad. is lowered without any gain whatever. Not only are the high speed dots wasteful of margin, but the lack of proportion and rhythm in the signals is very trying to the receivers. There is no gain in speed and much is lost in comfort when the dots are disproportionately rapid. The quadruplexes and duplexes have been improved and more improvements are coming, but it is bad practice to send out signals known to be much less perfect than they could easily be made. Everyone at repeater stations notices that the signals from sending machines are apt to be thin and chippy.

Sending operators always know when the dots are needlessly fast, and they can add to the comfort of receivers and help to make good signals by giving careful attention to the adjustment of their sending machines. The dot speed should be kept in strict relation to the speed of the dashes.

COPY OF CIRCULAR LETTER.

To all Managers,

New York, 1st February 1911.

You will get a number of copies of a circular in which an article upon "The effect of sending machines upon quadruplexes," by Mr. J. P. O'Donohue, has been reprinted from the "Postal Telegraph."

Please see that each operator in your office reads this circular and try to get the co-operation of all operators who use sending machines to so adjust them that receiving operators will not be obliged to worry about the character of the signals. There is great risk of error when the receiving operators are nervous because they are uncertain about the signals, and there is no real gain in speed when the dots are too fast.

Sending machines make the sender's work easier, and they enable some senders who have lost their grip to do good work, but these sending machines are so trying to receivers and so unsafe when they are not properly adjusted that the advisability of prohibiting their use is being seriously considered.

You will notice that Mr. O'Donohue, who is a first class operator thoroughly familiar with the actual use of these machines, points out that sending operators always know when the dots are too fast. It is very easy for the senders to maintain proper

adjustment. Chief operators should supervise the sending from these machines and also co-operate in sending out good signals.

Yours truly,
(Signed) C. C. ADAMS,
Vice-President.

It is probable that the Postal Company will in the near future prohibit entirely the use of semi-automatic keys by operators who are not disabled by cramp from using the ordinary keys.

Personal observation showed that the objections to which attention is drawn in the foregoing have a very real existence. In spite of the attention which had repeatedly been called to the necessity for carefully adjusting the speed at which the dots are sent out by the automatic vibrators of the keys, it was quite common to find that dots were being transmitted so fast as to be quite disproportionate to the manual elements of the signals. Such sending gives an impression of being far more rapid than it really is, and must considerably increase the strain of receiving and transcribing at any given speed in words per minute. Cases were observed in which signals of this character failed to pass through repeaters, although Morse key signals at the same aggregate speed were perfectly repeated.

There is no doubt, however, that the invention of semi-automatic keys has conferred an immense boon upon great numbers of American telegraphists, who would otherwise have been incapacitated by cramp from continuing in their profession, and has enabled them to retain positions in which they are doing useful and high class operating work. The Postal Company stated that a number of their operators who showed symptoms of cramp had been able to return to the use of ordinary Morse keys, alternately with semi-automatic keys, after the partial rest provided by the sole use of the latter for several months, but the Western Union Company could not trace any such cases. There is no record in either Company of the semi-automatic keys having themselves been the cause of any kind of cramp or paralysis.

The proportion of telegraphic work done in America by Wheatstone automatic or by machine printing telegraph systems is very small. In the Western Union Company it represents only from 3 per cent. to 5 per cent. of the total work, and in the Postal Company it is quite an inappreciable percentage.

At one time a considerable number of telegraphists suffered from "writer's" cramp; but this trouble has now been surmounted to a great extent by the general use of typewriters for transcribing received messages.

As in the case of semi-automatic keys, the typewriters used are the personal property of the telegraphists, or are hired by them at so much per month from firms who cater for their requirements. Each telegraphist is entirely responsible for the up-keep of his typewriter. The companies permit the use of any standard form of typewriter; and the types in use include the "Remington," "Smith-Premier," "Monarch," "Underwood," "Blickensderfer," "Royal," "Hammond," and "Densmore." From 60 per cent. to 75 per cent. of operators at the larger offices use typewriters, but they are not much used at small offices. The Western Union Company's system includes many small offices and the proportion of their *total* staff using typewriters is stated to be about 18 per cent. The Postal Company states that 75 per cent. of all telegrams delivered to the public are in typewritten form, the remaining 25 per cent. being in manuscript. The Western Union Company was unable to give aggregate figures on this point, but made a special examination of 2,884 telegrams sent out for delivery from their New York Office, with the following result:—

Typewritten from Morse sounder	-	-	-	1,988 or 69 per cent.
Printed by machine telegraphs	-	-	-	354 or 12 per cent.
Written in manuscript from Morse sounder	-	-	-	542 or 19 per cent.
Written in manuscript from Wheatstone slip	-	-	-	None.

I was informed by both Companies that in no case had an operator been discharged on account of cramp contracted in the service of the Company. In some instances such operators have been assigned to non-operating duties, generally with reduced remuneration, and in all cases without any compensation. Operators whose efficiency as telegraphists is impaired by cramp have also to suffer some reduction in scale of pay.

I think there can be no doubt that in America telegraphists work under much harder conditions than in England; and the appearance of an average instrument room there suggests a much more definite idea of strain upon the operating force. The operators face each other across tables about 3 feet 6 inches wide; and, as a rule,

the amount of "elbow-room" allowed is very small. The rooms are exceedingly noisy on account of the large number of typewriters in use, and also for the reason that with the "closed circuit" system of working the sounders reproduce sent signals as well as received signals. The sounders are fitted in small adjustable sounder screens which can be brought fairly close to the ear of the receiving operator, but, in spite of this, most of the operators appear to find it necessary to adjust their instruments so as to make as much noise as possible and I observed that it had been thought necessary to extemporise additional resonators in many cases by squeezing such articles as tobacco tins between the sounder and the screen. There is an air of strenuous work throughout most of the instrument rooms, no doubt due to the fact that a record of the work of each individual is kept and effectively used; and very strict discipline appears to be maintained.

(Signed) T. F. PURVES,
20th June 1911.

APPENDIX No. 5.

Revised Instructions for Sending.

NOTICE.

The Postmaster-General wishes to impress upon telegraphists the importance of a good style of sending with the Morse key. A bad style prevents good and rapid working, and is likely to cause fatigue and may even lead to telegraphists' cramp.

The Postmaster-General recognizes that one style will not suit all telegraphists, and that a good telegraphist may vary his style according to the kind of key he is using and for the sake of change; but there are features common to all good styles, and careful attention should be given to the following general directions:—

- (1) Sit comfortably directly facing the table with the chair a little to the left of the key.
 - (2) Put the first and second fingers lightly on the knob of the key, the thumb under the knob to steady the hand and keep it in position; and let the third and fourth fingers hang freely.
 - (3) The elbow should be held a little away from the body so that the action of the wrist may be as free as possible; and the hand and forearm should be level and in a line with the key. The whole position should be quite free from rigidity or constraint; and the chair should be of a suitable height to admit of this.
 - (4) The signals should be sent with an easy free wrist-action; and no more force should be used than is necessary to depress the key so as to make definite contact with the bottom stud.
 - (5) After each letter, the knob may be momentarily released and the hand slightly raised; though this release is not essential provided that otherwise the action is perfectly easy and without a rigid grip.
 - (6) The knob should never be gripped tightly, nor held so as to cause stiffness or constraint. To grip the key requires undue effort, and may lead to fatigue and difficulty.
 - (7) A tapping style should be avoided and the arm should not rest on the table. Neglect of this instruction may also lead to difficulty.
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APPENDIX No. 6.

Memorandum by Mr. Purves about Morse Keys and other Telegraph Apparatus used in the British Telegraph Service.

I submit for the information of the Committee the following notes regarding the various forms of transmitting keys, &c., used in the British telegraph service:—

(1) MORSE KEYS—(used for manual transmission of the dots and dashes of the Morse alphabet). “*Keys S.C.*” (single current) are used on short circuits. They are fitted with hard metal contacts. The amount of play between the contacts and the pressure necessary to operate the key can be very easily adjusted by the telegraphists to suit individual preferences.

“*Keys S.C. with switch*” are used at offices equipped with “universal batteries” on circuits which are worked “double current.” They have hard contacts. The minimum amount of play is fixed, so far as the telegraphist is concerned; its alteration is a workshop adjustment. The operating pressure and the maximum play can be readily adjusted by the telegraphists.

“*Keys D.C.*” (double current) are used on circuits worked “double current” at offices not provided with universal batteries. The contacts are made by flexible springs. The play of the lever is limited by a leather buffer, and its alteration is a workshop adjustment. The operating pressure can be regulated without unfixing the keys, but the use of tools is necessary, and the operating telegraphists are not allowed to make such adjustments.

“*Keys 6 Terminal, reversing*” are used for quadruplex working. The conditions mentioned in connection with “*Keys D.C.*” apply also to these keys.

(2) DOUBLE TAPPER KEYS, known as “Commutators,” require the use of both hands. The Morse alphabet is employed, but all signals are of equal length, the dots being struck with the left hand and the dashes with the right hand. They are used in connection with “*Single Needles*,” an old type of telegraph instrument now used only to a very slight extent by the Post Office, but still generally used by railway companies. Similar commutators are used by the Post Office in conjunction with “*Bright's Bells*” and “*Double Plate Sounders*,” on which the signals are produced by strokes on two sounding plates of different pitch.

(3) “WHEATSTONE A.B.C.”—The transmitting portion of this instrument includes a circular range of keys corresponding to the various letters of the alphabet, &c. Current is produced by means of a generator driven continuously by the operator's right hand, the keys being manipulated by means of the left hand. Signals are read by means of an indicating needle which stops momentarily opposite each letter corresponding to the key depressed by the sending operator. Little or no training is required to work these instruments, but the rate of working seldom exceeds five or six words per minute. They are only used on private wires and village circuits, and are gradually being superseded by the telephone.

(4) “WHEATSTONE AUTOMATIC.”—This is a high-speed system in general use on busy wires, where it can be worked at a rate of from 200 to 300 words per minute. It can be worked “duplex” at practically similar speeds in both directions. Transmission is effected mechanically by means of perforated paper tape prepared independently by telegraphists referred to as “punchers.” The telegraphist in charge of the automatic transmitter is known as a “key-clerk.”

The “*Perforator*” commonly used for the preparation of the transmitting tape includes three plungers operated manually by means of “punching sticks.” “Dots” are struck on the left hand plunger, “spaces” on the central, and “dashes” on the right.

In the Central Telegraph Office, where it is sometimes necessary to prepare as many as eight similar perforated tapes at the same time, a large number of “*pneumatic perforators*” are in use; the power required to perforate the tapes is supplied by compressed air acting on valves under the control of three light keys manipulated by the operator. Several forms of “*Keyboard perforator*” (machines in which the transmitting tapes are prepared by the manipulation of letter keys similar to those of a typewriter) have recently been tried, and their use promises to become

permanent, although none of them can yet be looked upon as standard Post Office instruments. They include the Kotyra, Creed, Gell, and Pollak-Virag, associated with the Wheatstone system, as well as others which have been designed for use with special systems of machine telegraphs.

Received signals on the Wheatstone system are recorded in the Morse alphabet on thin blue tape, and are transcribed by telegraphists known as "slip writers," or typed by typists. Practical working trials are at present being made of the "*Creed receiving perforator*," which reproduces perforated Wheatstone tape identical with the transmitting tape, and of the "*Creed Printer*," by means of which the signals recorded on this tape are automatically converted into printed roman characters.

(5) The "HUGHES" system is used principally on wires communicating with foreign countries. Transmission is effected by means of a "piano" keyboard, each lever of which corresponds to a letter or other signal. Received signals are recorded in plain roman type on a continuous paper tape. The Hughes system can be worked duplex.

(6) The "BAUDOT" is a multiplex printing telegraph, which, as used in this country, provides four independent channels of communication on the same circuit. So far it is only in regular use on wires to the Continent. Direct manual transmission is employed, the letters, &c. being formed by the depression of combinations of keys on a five-key manipulator. The alphabet used was specially devised by Monsieur Baudot. The signals have to be sent at perfectly regular intervals, and the operator is guided in this respect by an audible "cadence" given out by the apparatus. A keyboard transmitter designed to take the place of the present manipulator is now under trial.

The Baudot receiver prints in roman type on a continuous tape.

(7) The "MURRAY AUTOMATIC" is not now in use. It was tried recently and further trials are about to be made. It is a high speed "machine" system worked by means of perforated tape and utilising the "Baudot" alphabet. Keyboard perforators are used for preparing the tape, which is then run through the automatic transmitter. The signals are received at the distant end of the line on a "receiving perforator" which produces a facsimile of the transmitting tape. This tape passes at once (without handling) through an automatic translator which prints the messages in plain type on the actual forms sent out to the public. The rate of transmission is from 100 to 150 words per minute.

(8) The approximate numbers of telegraph keys and other forms of transmitting apparatus in use are shown below :—

Morse Keys.	Total Number purchased.	Number scrapped.	Number now in stock, including "repairable."	Number in use, including spares held locally.	First cost (each).	Cost of maintenance per annum per key.	
Hard contact Keys.	S.C. - - - -	7,893	208	1,052	6,633	£ s. d. 0 12 6	s. d. 0 10
	S.C. with switch -	3,674	34	655	2,985	1 4 6	1 3
Spring contact Keys.	D.C. - - - -	7,552	184	3,346	4,022	3 5 0	3 3
	Quad, &c. - - -	2,045	138	776	1,131	3 0 0	4 4

(NOTE.—Most of the D.C. keys remaining in use are at small offices.)

	Estimated Number in use.	First Cost (each or per set).	
		£ s. d.	
Double Tapper instruments.	Single Needles - - - -	650	5 15 8
	Double Plate Sounders and Brights' Bells (complete sets)	180	12 5 0
	A.B.C. Communicators - - - -	3,500	5 19 0
Hughes instruments, complete	138	72 0 0	
Baudot " " - - - -	24	344 0 0	
Wheatstone transmitters - - - -	650	24 0 0	
Keyboard perforators - - - -	40	70 0 0	

The statistics of apparatus maintenance costs compiled in the Engineering Department deal with complete sets of the various kinds of apparatus, and not with keys as separate items. It was, therefore, only possible to obtain the foregoing figures of annual costs by considering the relationship between the number of keys of each type in use and the extent and cost of repairs. For this purpose "repair" data from 1st January 1907 to 31st March 1910 were summarised. The period—3¼ years—is too short for very accurate averages, and the number of keys in use during that period can only be estimated approximately without entering into very laborious detail. The following statement shows how the figures were arrived at; and they may, it is thought, be accepted as a reliable general indication of the cost of maintaining the various types of Morse key.

Type of Key.	Period 1st January 1907 to 31st March 1910. 3·25 years.			Frequency of repair from foregoing data (1) × 3·25 (2)	Cost of maintenance per key per annum. (3) (4)
	Estimated average number in use.	Number repaired.	Average cost of repair.		
	(1)	(2)	(3)	(4)	(5)
			s. d.		s. d.
"S.C." (hard contact) - -	5,500	2,765	5 4	6½ years	0 10
"S.C." with Switch (hard contact)	3,000	3,118	4 0	3¼ "	1 3
"D.C." (spring contact) - -	4,000	6,091	7 0	2½ "	3 3
Quadx. &c. (spring contact) - -	1,000	1,197	12 0	2¼ "	4 4

(9) With reference to the suggestion of the Postal Telegraph Clerks' Association that the "Double Plate Sounder" system should be reintroduced, I submit the following statement in which its cost is compared with that of the ordinary Morse system as now worked on short circuits:—

System.	First cost, per station.		Approximate cost of engineering maintenance per annum.
	Detail.	Total.	
Double Plate Sounder (central offices).	Commutator and cover - 2 9 6	12 6 2	15 0
	Sounder D.P. 900 ω , including 2 plate sounders, galvanometer, and screen - - - 4 18 3		
	Relay B neutral - - 3 18 9		
	2 Res. Coils MC - - 0 19 8		
	(Battery cost omitted.)		
Do. (out offices)	As above - - - 12 6 2	17 9 8	App. - 1 10 0
	Plus batteries - - 5 3 6		Batt. - 3 0 0
			<u>4 10 0</u>
Single Needle (out offices) -	Inst. - - - 5 18 8	10 5 2	App. - 0 8 6
	Batteries - - - 4 6 6		Batt. - 2 10 0
			<u>2 18 6</u>
Common Battery Morse Sounder (central offices).	Sounder Pold., D - - 2 1 0	5 17 6	7 10
	Screen - - - 0 13 10		
	Key S.C. - - - 0 12 6		
	Coil Bdg. 3000 ω - - 0 3 3		
	Galvr. S.C. - - - 2 1 0		
	Condenser 2 m.f. - - 0 5 11		
	(Battery cost omitted.)		
Do. (out offices)	Sounder Pold., D - - 2 1 0	2 19 5	10 6
	Key S.C. - - - 0 12 6		
	Condenser 2 m.f. - - 0 5 11		

The figures given above do not show the cost of apparatus adjustments made from day to day by the traffic branch. The amount of readjustment required by D.P.S. apparatus exceeds, several times over, that necessary for the C.B. sounder system, and the consequent interruptions of communication are correspondingly more numerous. In the D.P.S. system, intermediate offices at some distance from the main line route have to be served by double wires looped into the office from the main line. In the C.B. sounder system such offices are served much more cheaply by single wires joined up as spurs from the main line.

D.P.S. apparatus is not capable of being worked on a "Central Battery" system; and, since the instruments at all offices on a circuit are in series, the number of cells in the battery at each office has to be increased when a new office is added to the circuit.

When there are several sets of D.P.S. instruments in one office, it is difficult to secure that the pitch of the sounding plates on the various instruments shall be sufficiently uniform to prevent telegraphists, who have to move from one to another in the course of their duties, from getting the impression of "reversed" signals on some of the sets.

T. F. PURVES.
21st June 1911.

I N D E X.

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