

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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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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DEPARTMENTAL COMMITTEE ON TELEGRAPHISTS' CRAMP.

TABLE OF CONTENTS.

	PAGE.
REPORT -	3
	PARAGRAPH.
INTRODUCTORY -	1 3
METHODS OF ENQUIRY -	2 3
HISTORY OF TELEGRAPHISTS' CRAMP -	4 4
DEFINITION -	9 5
PREVALENCE -	12 6
CAUSES -	22 9
Constitutional weakness -	24 10
Inaptitude for telegraph work -	25 10
Nature and amount of a telegraphist's work and conditions under which it is done -	27 11
Telegraph annual returns (the "average system") -	30 12
Returns of Morse sounder working -	33 13
Arrangement of duties -	37 15
Work on newspaper "special wires" -	39 15
Staffing of offices -	40 16
Overtime -	41 16
Bad style of manipulation -	42 17
Too early responsibility -	43 17
Heavy manual work -	46 19
Morse keys -	47 19
Inadequate working accommodation -	48 20
General conclusions -	49 20
MEANS OF PREVENTION -	50 20
<i>Prevention of the appointment of persons predisposed to cramp :</i>	
Recruitment -	51 20
General examination -	53 22
Medical examination -	54 23
Rejection during learning and probation -	55 23
<i>Prevention of nervous breakdown and prolonged fatigue in appointed telegraphists :</i>	
Training of learners -	56 24
Organization -	66 26
Instruments and apparatus :	
Morse keys -	68 27
Arm rests -	73 28
Substitutes for Morse key -	74 29
Alternative systems of telegraphy -	79 30
Relief circuits for cramp subjects -	81 32
Chairs -	83 33
SUMMARY OF RECOMMENDATIONS -	84 33
APPENDIX :	
APPENDIX No. 1.—Report of Medical Sub-Committee -	36
APPENDIX No. 2.—List of Witnesses -	54
APPENDIX No. 3.—Reports from Telegraph Administrations of Austria, Belgium, France, Germany, and Italy ; and from Mr. Newlands about India -	55
APPENDIX No. 4.—Report by Mr. Purves on Telegraphists' Cramp in the United States of America -	60
APPENDIX No. 5.—Revised instructions for Morse sending -	67
APPENDIX No. 6.—Memorandum by Mr. Purves about Morse keys and other telegraphic apparatus used in the British telegraph service -	68
INDEX -	72

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 ^{you} 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} _{you} 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.

(Figures in *italics* refer to paragraphs of Report.)

- Ambidexterity :**
 relief from cramp afforded by - - 9 (*19*), 41
 should be encouraged - - - 26 (*65*)
 among cramp subjects - - 39, 52, 47, 48, 49
 in Belgium - - - 57
 in United States of America - - 62
Arrangement of telegraphists' duties - 15 (*37*),
 27 (*67*)
- Austria :** reply to inquiry about tele-
 graphists' cramp in - - - 55
Autodot : *see* Vibroplex.
Automatic telegraph instruments, in-
 creasing use of - - - 4 (*4*)
- Average system :**
 evidence of Postal Telegraph Clerks'
 Association - - - 11 (*28*)
 evidence of Post Office officials - - 12 (*29, 30*)
 not a cause of cramp - - 12 (*31*), 20 (*49*)
 standard of 24 messages an hour - - 13 (*32*)
- Baudot telegraph instrument :**
 cramp associated with - 6 (*11*), 9 (*20*), 36
 use of - - - 31 (*79, 80*)
 description and cost - - - 69
- Belgium :** reply to enquiry about
 telegraphists' cramp in - - - 56
Brights' Bell instruments 4 (*4*), 31 (*79*), 68, 69
Central Telegraph Office :
 examination of staff of "F" division 3 (*2*),
 7 (*14*), 37, 51
 returns of Morse sounder working in
 "D," "F," and "K" divisions - 13 (*33*)
 overtime in - - - 16 (*41*), 43
 conditions of employment of young
 telegraphists in - - - 17 (*43*), 18 (*45*)
 training of learners in - - - 17 (*44*)
 relative use of telegraph systems in - 32 (*80*)
 no case of cramp found in Cable Room 38
Chairs - - - 28 (*72*), 33 (*83*), 34 (*84*)
- Circular to staff :**
 issue of - - - 3 (*2*), 7 (*14*), 37
 analysis of answers to - - 8 (*15*), 38, 51
 copy of - - - 50
- Cronbach, Dr. E., publishes paper on**
 telegraphists' cramp - - - 4 (*5*), 38, 45
Double Plate Sounder instruments :
 description, cost, &c. - - 31 (*79*), 68, 69
 comparison with Morse - - - 70
 re-introduction not recommended - 32 (*82*)
- Fatigue :**
 difficulty due to - 8 (*15, 16*), 10 (*26*), 38, 43
 as a cause of cramp - - - 9 (*22*), 20 (*49*)
 and continuous sending - - - 15 (*38*)
 and overtime - - - 16 (*41*), 43
- France :** reply to inquiry about tele-
 graphists' cramp in - - - 57
Fulton, Dr. T. W. :
 publishes paper on telegraphists' cramp 4 (*5*), 45
 describes signs shown by cramp subjects 40
 describes movements made in Morse
 keying - - - 41
- Germany :** reply to enquiry about tele-
 graphists' cramp in - - - 57
- Hughes telegraph instrument :**
 use of, to prevent cramp - - - 4 (*5*), 45
 cramp associated with - - 4 (*5*), 6 (*11*),
 9 (*20*), 36, 38, 42, 45, 58
 use of - - - 31 (*79*), 32 (*80, 82*)
 description and cost - - - 69
- Inaptitude for telegraph work :**
 as a cause of cramp - - - 9 (*23*),
 10 (*25, 26*), 20 (*49*), 44
- Inaptitude for telegraph work—cont.**
 rejection on account of - - - 10 (*25*),
 23 (*55*), 33 (*84*), 44
 due to age when training begins - - 11 (*26*)
 indications of - - - 23 (*54*)
- India :** report by Mr. Newlands on tele-
 graphists' cramp in - - - 59
- Industrial Diseases Committee :**
 enquiries of, with regard to telegraphists'
 cramp - - - 5 (*7, 8*)
 recommend that telegraphists' cramp
 be scheduled under the Workmen's
 Compensation Act - - - 5 (*8*)
 returns furnished to - - - 6 (*12*), 8 (*18*)
 evidence given by Postal Telegraphs
 Clerks' Association - - - 11 (*27*)
 report on cramp - - - 5 (*8*), 40
- Instructions for sending, revised** - 24 (*56*), 67
- Italy :** reply to inquiry about telegraph-
 ists' cramp in - - - 58
- Instructors in telegraphy** - 25 (*59, 60*), 34 (*84*)
- Keyboard perforators** - 31 (*79*), 32 (*82*), 69
- Leeds :** returns of Morse sounder work-
 ing - - - 13 (*33*)
- Left-handedness** - - - 23 (*54*)
- Liverpool :** returns of Morse sounder
 working - - - 13 (*33*)
- Manipulation of Morse key :**
 style of, in relation to cramp - 10 (*23*), 17 (*42*),
 20 (*49*).
 features of good styles of - - - 24 (*56*)
 revision of card of instructions for - 24 (*56*), 34 (*84*),
 67.
 style of, in cramp subjects - - - 40
- Mecograph :** *see* Vibroplex.
- Medical examination of candidates** - 23 (*54*), 33 (*84*)
- Medical Sub-Committee :**
 appointed - - - 3 (*2*)
 report of - - - 3 (*2*), 36
- Morse keys :**
 manipulation of, as a cause of telegraph-
 ists' cramp - - - 19 (*47*), 20 (*49*)
 adjustment of - 19 (*47*), 28 (*71*), 41, 55, 56, 63, 68
 types of - - - 19 (*47*), 27 (*68*), 68
 D.C. keys preferred to S.C. keys on
 heavy circuits - - - 20 (*47*)
 general use of D.C. keys for training
 learners recommended - - 25 (*59*), 34 (*84*)
 use of D.C. keys on important circuits
 recommended - - - 28 (*70*), 34 (*84*)
 criticisms of - - - 27 (*68-70*)
 finger knobs - - - 27 (*69*), 59, 63
 contacts (hard or soft) - - - 27 (*70*)
 height of, above table - - - 28 (*72*)
 position of, on table - - - 28 (*73*), 55
 substitutes for - - - 29 (*74*)
 complaints about - - - 53
 kind used in Belgium - - - 56
 kind used in India - - - 58
 kind used in America - - - 63
 kinds used in British service - - 68
 number in use and cost - - - 69, 70
- Morse telegraph instrument :**
 cramp associated with - 4 (*4*), 6 (*11*), 9 (*20*), 36,
 38, 42
 use of, by telegraph companies and by
 Post Office - - - 4 (*4*)
 apparatus recommended for the training
 of learners - - - 25 (*59*)
 description by Dr. Fulton - - - 41
- Nervous instability, a cause of cramp** - 9 (*22*), 10
 (*24*), 19 (*47*), 20 (*49*), 42, 44

- Nervousness of temperament - - 10 (24), 23 (54)
- Onimus, M. : publishes paper on telegraphists' cramp - - - 4 (5), 45
- Overtime - - - - 16 (41), 43
- Postal Telegraph Clerks' Association :
 memorial from, referred to Committee - 3 (1), 17 (43).
 evidence of, upon the work of a telegraphist - - - 11 (27, 28), 15 (39)
 _____, upon Morse keys - 27 (70), 28 (71) (72).
- Postal Telegraph Company, U.S.A. :
 conditions of work and staff - - 9 (21), 60, 63
 prevalence of cramp among staff - 9 (21), 60
 work done by telegraphists - - 14 (34), 61
- Purves, T. F. :
 report on telegraphists' cramp in United States of America - - 60
 memorandum on Morse keys and other telegraphic apparatus - - - 68
- Recommendations : summary of - - 33 (84)
- Recruitment of telegraphists :
 past and present methods compared - 10 (25)
 from messengers - - - 10 (25), 21 (52)
 by competitive examination - 10 (25, 26), 22 (53)
 methods of - - - - 20 (51)
 limits of age for candidates - 22 (53), 33 (84)
 subjects of examination - - 22 (53), 33 (84)
 medical examination - - - 23 (54), 33 (84)
- Reference to Committee : terms of - 3 (1)
- Robinson, Dr. E., reads paper on telegraphists' cramp - - - 4 (5), 45
- Semi-automatic keys - - 29 (75-77), 33 (82), 34 (84), 63.
- "Simplex" and "duplex" working - 15 (38)
- Single needle telegraph instrument - 4 (4), 31 (79), 69, 69.
- "Special Wire" (newspaper) duties - 15 (39)
- Staffing of offices - - - 11 (27), 16 (40)
- Supervision of telegraphists - 19 (45), 26 (66), 27 (67), 34 (84).
 of the training of learners - 26 (64), 34 (84)
- Telegraph Annual Returns : nature and use of - - - 12 (30-32), 16 (40)
- Telegraphists :
 description of movements made by, when keying - - - - 41
 and typists, comparison of movements per minute - - - - 42, 53
- Telegraphists suffering from cramp :
 seen by Committee - - - - 3 (2), 36
 given non-manipulative work - - 4 (5), 5 (6)
 difficulty in finding work for - - 5 (6)
 not necessarily disabled - - - 9 (19), 37, 40
 disability not limited to telegraphy in
 long standing cases - - - - 37, 40
 service when difficulty commenced - 39, 52
 details of six cases - - - - 45
- Telegraphists' cramp :
 history of - - - - 4 (4-7)
 associated with use of Morse key - 4 (4) (5), 6 (11), 9 (20), 19 (47), 36, 38, 42.
 associated with use of Hughes instrument - 4 (5), 6 (11), 9 (20), 36, 42, 45, 58.
 associated with Baudot instrument - 6 (11), 9 (20), 36.
- scheduled under Workmen's Compensation Act - - - - 5 (8)
 definition of - - - - 5 (9), 36
 early subjective stage of - 5 (10), 6 (13), 36, 41
 different forms of, associated with different instruments - 6 (11), 19 (47), 20 (49), 36, 42.
 symptoms - - - - 36, 39, 40
 diagnosis - - - - 6 (13), 40
 pathology - - - - 42
- Telegraphists' cramp—*cont.*
Causes :
 nervous instability and fatigue - 9 (22), 20 (49), 42, 44.
 constitutional weakness - 9 (23), 10 (24), 20 (49).
 inaptitude for telegraph work - 9 (23), 10 (25) (26), 44.
 nature, amount and conditions of a telegraphists' work - 9 (23), 11-16 (27-41)
 bad style of manipulation - 10 (23), 17 (42), 20 (49).
 too early responsibility - - 10 (23), 17 (43), 18 (45), 20 (49).
 heavy manual work - - 10 (23), 19 (46)
 construction of Morse keys - - 10 (23), 19 (47), 20 (49)
 inadequate working accommodation - 10 (23), 20 (48)
 continuous sending for long periods - 15 (38, 39)
 general conclusions on - - - 20 (49)
- Prevalence :*
 probable cases of cramp at time of transfer (1870) - - - - 4 (5)
 Dr. Fulton's opinion on (1884) - - 4 (5), 45
 returns furnished to Industrial Diseases Committee (1908) - - - 6 (12), 8 (18)
 methods of determining - - - 6 (13)
 in "F" Division of Central Telegraph Office - - - - 7 (14), 37, 51
 in all large offices - - - - 8 (15), 38
 in relation to sex - - - 8 (16), 9 (21), 39
 in relation to length of service - - 8 (17)
 in "amalgamated" offices - - - 8 (18)
 in foreign countries - - - 9 (21), 55, 60
 increase in, due to changes in methods of recruitment - - - 10 (25)
 among special wire telegraphists - 16 (39)
- Means of prevention :*
 work on Hughes instrument - - 4 (5)
 recruitment from boy messengers and girl probationers - - - 21 (52)
 typing and handwriting as subjects of examination - - - - 22 (53)
 medical examination - - - - 23 (54)
 rejection of inapt learners - - - 23 (55)
 training of learners - - - 24-26 (57-65)
 supervision of work of young telegraphists - - - 27 (66, 61)
 limitation of continuous sending or receiving - - - - 27 (67)
 modification of Morse keys - - 27 (69, 70)
 adjustment of Morse keys - - - 27 (71)
 arm rests - - - - 28 (73)
 semi-automatic keys - - - - 29 (74)
 Twentieth Century key - - - - 30 (78)
 systems of telegraphy other than the Morse - - - - 30 (79)
 relief circuits for cramp subjects - 32 (81, 82)
 chairs - - - - 33 (83)
 suggestions of Medical Sub-Committee 44
 in Belgium - - - - 56
- Telegraphists' work :
 as a cause of cramp - - - 9 (23), 11 (27)
 returns of Morse sounder working in the Central Telegraph Office and at Leeds and Liverpool - - - 13 (33)
 and rate of working in the United States of America - - - 14 (34), 61, 65
 rate of working of young telegraphists 14 (35)
 on newspaper "special wires" - - 15 (39)
 of young telegraphists in the Central Telegraph Office - - - 17 (43)
 difficulties of - - - - 18 (45)
 rate of working in Austria - - - 55
 " " Belgium - - - 57
 " " France - - - 57
 " " Germany - - - 58
 " " Italy - - - 58

Telegraph systems :			Typists and telegraphists, movements	
other than the Morse	- - -	30 (79)	of per minute, compared	- - - 42, 53
relative use, in Central Telegraph			United States of America :	
Office	- - -	32 (80)	prevalence of cramp in	- - - 9 (21), 60
relative use in various countries	- - -	59	work done by telegraphists in	- 14 (34), 61, 65
description of various	- - -	68	experience of semi-automatic keys in	29 (76), 63
Telephone : use of in telegraphy	- - -	31 (79, 80)	report by Mr. Purves on operating	
Training of learners in telegraphy :			conditions and on telegraphists'	
age when training should begin	- - -	11 (26)	cramp in	- - - 60
in Central Telegraph Office	- - -	17 (44)	Vibroplex key	- - - 29 (75-77), 34 (84), 62, 63
importance and object of	- - -	24 (56)	Western Union Telegraph Company, U.S.A. :	
present arrangements for	- - -	24 (57)	conditions of work and staff	- - - 9 (21), 60, 63
recommendations regarding	- 24-26 (58-65),		prevalence of cramp among staff	- - - 9 (21), 60
	34, (84).		work done by telegraphists	- 14 (34), 61, 62
at teaching centres	- - -	24 (58)	Wheatstone A.B.C. communicator	31 (79), 68, 69
apparatus for	- - -	25 (59), 34 (84)	Wheatstone automatic telegraph	- 31 (79, 80),
instructors	- - -	25 (59), 34 (84)		68, 69.
methods of	- - -	26 (61, 62)	"punching"	- - - 31 (79), 32 (82), 68
supervision of	- - -	26 (64), 34 (84)	Workmen's Compensation Act : tele-	
Twentieth Century key	- - -	30 (78), 63	graphists' cramp scheduled under	- 5 (7, 8)
Typewriters : use of in America	- - -	65	Writers' cramp :	
Typing :			similar to telegraphists' cramp	- 4 (5), 6, 36, 45
as an examination subject	- - -	22 (53)	no instance of, discovered in examina-	
knowledge of, desirable	- - -	32 (82), 34 (84)	tion of replies to circular	- - - 39