REPORT

ADMINISTRATION

OF THE

METEOROLOGICAL DEPARTMENT

OF THE

GOVERNMENT OF INDIA

IN

1921-22

SIMLA
SUPERINTENDENT, GOVERNMENT CENTRAL PRESS
1922

Price Four Annas.

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weather very seldom realise that it
the greatest value to other ships by
service.

The warnings issued during the year, chiefly
officers, for heavy rain likely to cause floods were the occasi... appreciative reports. In addition telegrams were sent to three military authorities in connection with the operations in Waziristan ; and of these the General Officer Commanding said "throughout the operations of 1920-21 and the Wana Column operations these wires have been of the greatest value.'

Owing to the stringency of the financial situation no progress has been made in the project of transferring the work of the Colaba observatory and of the Bombay Meteorological Office to a single combined institution at Juhu, where the Bombay aerodrome was to be established. Two other building projects have been prepared and have received administrative approval, one for a new engine house at Agra and the other for a new wing to the Simla office, which has at present no workshop and quite insufficient library accommodation.

The chart at the end of the report illustrates the general changes in activity and in budget provision for the year.

Changes in the staff during the year.

2. Mr. W. A. Harwood, M.Sc., resigned his appointment, and Mr. T. K. Chinmayanandam, M.A., reverted to the Finance Department, during the year.

Mr. G. Chatterjee, M.Sc., and Mr. V. V. Sohoni, B.A., B.Sc., joined the Department and were appointed Meteorologists, being posted to Agra and Simla respectively.

Mr. P. N. Mitra, Meteorologist, Bombay, made over charge to Mr. W. A. V. D'Rozario on the forenoon of the 1st April 1921.

Dr. Savoor took over charge of the post of Meteorologist, Madras, from Mr. Barnes from the 4th May 1921.

The system of storm warning

3. The work of warning Indian ports of the approach of cyclonic storms or of bad weather is performed from the Simla office by the Director-General of Observatories, and from the Calcutta office by the Meteorologist, Calcutta.

Thirtytwo ports are warned from Simla for storms in the Arabian Sea. Fortyone ports and nineteen River Police stations were on the list at the beginning of the year for warnings from Calcutta for storms in the Bay of Bengal ; but of these Table Island and seven River Police stations were subsequently discontinued. In addition to these special messages sent during stormy weather the Meteorologist, Calcutta, provides shipping at thirteen ports, with daily information regarding the weather over the Bay under a special system of "additional" signals. Shipping at sea is also supplied with the latest information regarding the weather by means of wireless bulletins, which are trans-

at Bombay, Karachi, Calcutta, and Aden. The weather bulletins arch 1920 at the request of the arning system may be found in the ase at Indian Ports ", obtainable from inting, India, at Calcutta.

Warnings for storms in the Bay of Bengal.

4. During the year warnings were issued for nineteen disturbances, but none of them was classed as " severe ". During six of them (21st-30th July, 31st August-4th September, 5th-8th October, 24th-27th October, 7th-9th November and 27th-30th December) winds at sea reached gale force ; the first and fifth were storms of moderate intensity and others of only slight intensity. The warnings were correct and complete except that in the fourth storm on the 25th October the depression was located in the south-west instead of the centre of the Bay and that during the moderate storm of the 7th to 9th November a careless barometer reading from Diamond Island led to an inaccuracy in fixing the position of the storm centre on the morning of the 7th: this error was brought to light and corrected ten hours later. In addition to the nineteen disturbances mentioned above there was a disturbance between the 7th and 9th April which moved from the southwest of the Bay and disappeared off the north Madras coast: although winds reached gale force in this on one day it did not develop into a cyclonic storm, was difficult to detect from the land observations and passed unnoticed: so far as is known no loss resulted.

Warnings for storms in the Arabian Sea during the year.

5. The Simla office warns the west coast ports not only for storms, but also for squally weather, especially at the beginning of the monsoon. There were nine periods of disturbed weather in the Arabian Sea for which warnings were issued ; and only one of these disturbances, that of October 9th-13th, developed into a cyclonic storm. This originated in the Bay where it was so small that, although it had a core with hurricane winds, it was hardly felt at a distance of 60 miles from the centre ; and no indications were given at the coast stations of its severity. It crossed the Peninsula with quite unusual rapidity and developed into a severe storm in the Arabian Sea at once instead of in one or two days. In the absence of all wireless information from ships which had experienced its violence it was inevitable that this should be greatly under-estimated ; so the warnings were not hoisted early enough and were lowered too soon, and shipping and ports were warned for the existence of a depression only, instead of for a severe but small storm.

Flood Warning and Weather Forecasts to District, Irrigation, Railway and other officers.

6. This work is carried out chiefly by the Simla Meteorological Office, and partly by that of Calcutta. The arrangements have been made at various times and differ considerably in character, according to the nature and extent of the flood or weather warnings required by the officers concerned. In most cases

REPORT ON THE ADMINISTRATION OF THE DEPARTMENT OF THE GOVERNMENT

CHIEF FEATURES OF THE YEAR.

1. The efficiency of a scientific department is so completely dependent on the maintenance of a trained staff that the loss during 1921-22 of two officers in addition to the two of whom we were deprived in the previous year has been the most important fact in the history of the year ; and both officers, Mr. W. A. Harwood and Mr. T. K. Chinmayanandam, resigned on account of dissatisfaction with the pay and prospects of the department. Mr. Harwood was offered and accepted a post under the English Meteorological Office, and is greatly missed in the upper-air observatory at Agra. He had there done several years of active and valuable work ; and he was relied upon in connection with the increased activities of the observatory which, it had been confidently hoped, would have been possible after the conclusion of peace. Mr. Chinmayanandam was one of the most promising of the younger physicists of India ; but after some two years' service in training at Simla and as Director of the Bombay observatory he has reverted to the Accounts Department.

Mr. Harwood's vacancy was filled by Mr. Chatterjee of the Presidency College, Calcutta, and Mr. Chinmayanandam's by Dr. S. K. Banerji of the College of Science, Calcutta. To one of the vacancies of 1920 in the Simla office Mr. Sohoni of the Wilson College, Bombay, was appointed in March 1922 ; but the other vacancy is still unfilled. None of the newly appointed men had a technical knowledge of meteorology and it has been with very great difficulty that the routine work of the department has been carried on.

Fortunately however some progress in research work was rendered possible by the presence in the Simla office for some months of three workers not connected with the department : for their benefit weekly ' colloquia ' were held at which papers were read and discussed. Mr. J. C. Kameswara Rav, M.Sc., a research student from the Calcutta University, made a careful analysis of all the cold weather storms for the past twenty years and thus appreciably advanced the preparation of type maps for daily forecasting : Mr. C. Seshachar, M.A., in training for service in the Mysore State, investigated the evidence from the lakes of the Tata electric power company regarding the influence of forests and lakes on rainfall : and Mr. P. C. Mahalaonbis, a Calcutta Professor, critically examined by statistical methods some important European work on the inter-relations between pressure and temperature in the upper air. The methods of forecasting for the winter rains and for the monsoon have also been advanced a stage further : early in the year investigations on the monsoon of the Peninsula during the past 45 years led to a formula based on only three factors which predicts over two-thirds of the variations of the rainfall, as compared with a half, which was given by the formula of 1908 : formulæ for other parts of India were also obtained. A more recent examination of conditions at the centres of action which largely control

rther relations ; but very much
detailed forecast can be produced.

stigation by Mr. Field now completed
meters the department has always used
vent the sun's rays and the radiation from the
ing the instruments. These sheds are said to have cost formerly less than Rs. 200 but now are priced at about Rs. 800 ; and the employment of some different device for efficiently shading thermometers is therefore desirable. Experiments with other types of shed and with various louvred Stevenson screens have been in progress at Agra for the past two years and their characteristics are now known for use in India. As a result, Stevenson screens are to replace all sheds in India as opportunity offers, and as the new screens will cost only about Rs. 50 each, their use will result in saving annually about Rs. 9,000.

The scientific side of the upper air work begun in Agra in 1914 was hampered greatly during the war by the absence of officers on field service. This year however a real advance has been made in the discussion of results. From the pilot balloon observations which tell the velocity and direction of the upper winds we have gained a clearer conception of the general circulation over India in the two monsoons ; the instrument balloons which have been sent up to record the air temperature, pressure and humidity as they ascend, though not very numerous, have been sufficient to disclose the approximate values of these elements in the different seasons at all heights up to 35,000 feet. Memoirs giving all the available data of winds at various heights have been published for the use of aviators, and discussions of the other data on these subjects are ready for publication.

Upper air stations were started at Quetta and Peshawar to serve the needs of military aviators flying on the frontier. Similar observations were resumed at Calcutta and Akyab, and were continued at Agra, Lahore, Simla and Bangalore. Upper air measurements from all these stations except Bangalore are available every morning at Simla for use in preparing a daily telegram for aviators in north-west India and in forecasting the weather generally.

Mention was made last year of the increase in responsibilities of the department in relation to upper air work for the Royal Air Force. A further demand for similar information has been arising in connection with Artillery practice camps, and by way of trial three of these have been attended in the past by balloon parties from Agra. It is understood that as a result of the usefulness of the work done in these camps the demand in the coming year will be increased, and Agra has been provisionally asked to make arrangements to send balloon parties to eight camps ranging in site from Belgaum to Quetta. With the present staff it will not be possible to meet the whole of this demand.

The warnings for ports and shipping in the Bay of Bengal and the Arabian Sea were on the whole carried out successfully. In the light of the fuller information subsequently available from logs of ships, which enable us to test the inferences made at the time from the coast observations, we find that of the seven storms which formed, the warnings for four were correct :

The central observatory at Ag
the current work of these outstatic
arrears in the computation of upper-ai

A complete analysis of cloud observa
also of observations with kites and sounding balloons m
was undertaken, and three papers giving the results of this w compi
for publication in the India Meteorological Memoirs.

A paper " On exposures of thermometers in India " was sent to press for publication in the Memoirs, and two papers were prepared by Professor P. C. Mahalanobis, on the seat of activity in the upper-air and on the effect of errors of observation on upper-air relationships.

Researches by the Simla Staff.

9. Shortness of staff prevented any of the gazetted officers from carrying on systematically the preparation of type maps for daily forecasting, a matter of paramount importance.

Statistical work for investigating the relation of pressure at centres of action with the monsoon rainfall of the Peninsula was undertaken, and a formula was obtained which would enable the department to make a forecast in February with a correlation co-efficient nearly as high as that obtained with the old formula for the June forecast. For the forecast in June a formula was found which gave a correlation co-efficient of 0.8, *i.e.*, which should give indications regarding 80 per cent. of the variations of rainfall. The investigation was extended to the monsoon rainfall of north-west India also, but with less success.

Observatories.

10. The Directors of the solar physics observatory at Kodaikanal and of the magnetic observatory near Bombay publish separate annual reports to which reference may be made for accounts of their work.

The purely meteorological observatories under the department's care number 281, and include stations as far afield as Tehran, Kashgar, Aden and Seychelles. Their classification according to the frequency of the times of observation and to the number of elements observed was described in the 1918-19 report. While the maintenance of these observatories, the supply to them of tested instruments, and the careful scrutiny of their observations to detect mistakes naturally entail much work at headquarters, it seems unnecessary to deal with it in detail on account of its routine character. The correctness of observations depends upon the continuance of good exposure and condition of instruments at observatories, and upon the accuracy of reading by observers. The former point can only be secured by inspection visits of trained officers, but the latter can to some extent be estimated at headquarters from the data received. A judgment on the standard of accuracy maintained in reading the instruments may be gathered from the number of mistakes detected in the data for the Indian Daily Weather Report. The stations of great reliability, in which at most one mistake has been detected, numbered 12, while the number at which more than 50 mistakes were made was 9.

maintenance of accuracy in results
ded shortness of staff, and during the
pection has fallen to about a third of the
having to be left mainly to the single Inspector
of Observatories, Mr. P. K. Ghose. This officer inspected 35 observatories during the year, Mr. G. Chatterjee 3, while the Director-General of Observatories made inspections at Alipore, Agra, Bombay and Madras.

It was stated last year that it would be necessary to arrange for more frequent inspections in future, if reliance were to be placed upon the data of observatories, and with the recent appointments to vacant gazetted posts this should soon be possible.

Marine Meteorology.

12. The want of weather telegrams from ships at sea has always formed a difficulty in the determination of the movement and intensity of storms ; inferences had to be made from the coast observations only. To arrive at correct conclusions about storms in the Arabian Sea was especially difficult, as their movements had generally to be inferred solely from the observations received from the west coast of India, where moreover the Western Ghats have a disturbing effect upon the wind directions. Accordingly a system was organized in 1914 for collecting weather observations from ships by wireless telegraphy ; but shortly after its introduction it had to be stopped on account of the war and it could not be resumed until 1920. The Marconi Company were asked whether they would allow weather messages to be transmitted free of ships' charges, a concession allowed to one or two other countries and they agreed to this proposal, which took effect from the 1st July 1921. The system worked fairly well during the year, and the messages received during disturbed weather, though few, were very useful in determining the movement and intensity of storms.

The number of wireless weather messages from ships received at Simla during the year was 649. The thanks of the Department are due to the Commanders of vessels sailing in Indian waters for co-operating with it in this matter.

At Calcutta and Bombay a clerk at each port spends his whole time in visiting ships, making in each case a copy of the log and a comparison of the ship's barometer with a secondary standard, for the purpose of applying the necessary corrections to the readings in the logs ; and, after the barometer comparisons have been made, a statement of the error of the ship's barometer is given to the captain, in case he should desire to make use of it. The number of ships visited is materially less than that of the vessels which come into port, but it is ample for the purposes of the department.

The data thus obtained are utilised in the preparation of charts of disturbances in the Bay of Bengal and the Arabian Sea for future reference in connection with the storm warning work of the department, and in drawing up an account of the storms of the year for publication in the Annual Summary.

these officers require telegrams ca
to give heavy rain, or informing the
likely to give rise to severe floods wh
and in other cases, they require warn
long a period beforehand as possible.

The number of district officers and officers in the [illegible] other departments to whom flood warnings, weather forecasts or intimations of the likelihood of rain during the dry season were sent from Simla amounted at the end of the year to 231. There were also 7 officers of the Telegraph Department who required warnings for strong winds.

In order to provide against serious loss of life and property in inland Bengal when a cyclone from the Bay has crossed the coast 461 officers were added to the list of those warned by the Meteorologist, Calcutta ; of these 40 are requested to hoist signals under Appendix D of the Code.

The number of special forecast and warning messages sent from Simla during the year was 2938 and from Calcutta 820. In addition to the telegrams from the Meteorological offices at Simla and Calcutta 884 telegrams of actual heavy rainfall were sent by observers direct to various officers.

Instructions were issued by the Government of India in 1898 that every officer to whom storm or flood warnings are issued should, in the month of January of each year or, in the case of military expeditions, at the close of the campaign, forward to the head of this department a brief return of the warnings received and should also report whether the warnings were satisfactory and whether any changes might be made to increase the usefulness of the warnings.

Reports on the ordinary storm and flood warnings for the calendar year 1921 were received from 41 officers. Of these 24 stated that the warnings were satisfactory, and the remaining 17 offered no remarks.

A comparison of the reports of floods and of heavy rain with information supplied to the various officers would appear to show that the system is working satisfactorily, and that most of the warnings issued were of value to the recipients. As illustrations the following extracts from reports may be of interest :—

The Executive Engineer, Rupar Division, Sirhind Canal, wrote :—

> " They (the storm warnings) continue to be of interest and value to officers-in-charge of the Head-Works. These remarks apply equally to the telegraphic warnings and the daily weather reports ".

The Port Officer, Orissa Ports, False Point, stated that :—

> " Telegrams were satisfactory and effective in giving timely warnings in almost every case, except a few which were hindered in transit ".

The Chief Engineer in Sind stated that :—

> " The warnings were timely and satisfactory in every respect and no change in the system is wanted. I appreciate the care and regularity with which the warnings are issued by the Meteorological Department ".

'ivision, wrote :—

.8th July 1921) were very useful

ry quick rising flood ".

.LOGICAL INFORMATION.

.ne meteorological information published by the department, specia. .rmation was supplied to the Meteorological Departments of England, Australia and Egypt. Climatological information, at times involving special calculation, is also provided for sanitary and other officers of Government as well as for private firms who are willing to pay the expense necessarily incurred. The extent to which the department is utilised in this manner will be seen from the chart appended.

MEDICAL DEPARTMENT.

As in previous years the department has supplied information in connection with cases of heat-stroke among British soldiers. As information was required whenever the wet bulb temperature rose above 75 and as most of our observatories recorded readings at 8 hours only, wet maximum thermometers were maintained at nine cantonments in north-west India and the readings were supplied daily to the local medical authorities from the middle of April until September. The readings were also telegraphed daily to Simla and transmitted immediately to Army Headquarters, Medical Branch.

INFORMATION TO AVIATORS.

A general forecast for north-west India with a summary of the existing upper winds was telegraphed daily up to the 15th March 1922 to the Royal Air Force, Headquarters, who distributed the information to all squadrons concerned ; but in view of the financial stringency these daily telegrams were discontinued after the 15th March.

WARNINGS TO THE MILITARY AUTHORITIES IN WAZIRISTAN.

In response to a request for " early forecast by telegram whenever there is a likelihood of bad weather in Waziristan " warnings were sent to the General Officer Commanding Waziristan Force, Dera Ismail Khan, throughout the year, to the Officer Commanding, Wana Column, Jandola, till the 7th February 1922, and to the Army Headquarters, Kohat District, between the 5th January to the 8th March 1922. In asking for the continuance of these warnings to his address the General Officer Commanding the Waziristan Force remarked that " throughout the operations of 1920-21 and the Wana Column operations these wires have been of the greatest value ".

UPPER AIR WORK.

8. An increase in the number of pilot balloon stations was made, repairing to some extent the disadvantages suffered in the previous year from the necessity of closing stations and parting with trained staff. Thus Calcutta and Akyab pilot balloon stations were reopened in May and August, while Quetta and Peshawar were started in June and September respectively.

The arrangement made with Royal Alfred collecting marine data from the Indian Ocean, has thanks of this department are again due to that office for amount of useful data.

Snowfall Registration in the mountain districts to the north of India.

13. The information as to the amount, distribution and time of occurrence of the snowfall in the Himalayan and Afghan mountain areas was on the whole tolerably complete, and the thanks of the department are again due to the various officers who have collected and forwarded it.

Rainfall Registration.

14. The registration of rainfall in India has invariably been carried out by the provincial authorities. In 1889 a uniform system was introduced by the Government of India, and the Director-General of Observatories was made consulting officer in connection with this work. His advice is sought regarding the starting of new raingauge stations, and he receives annual reports from the local officers responsible for the registration of rainfall upon the efficiency of the work. A general account of the system, which came into operation in the year 1891-92, will be found on pages 5—8 of the Administration Report of the year 1889-90, and on pages 6 and 7 of the Administration Report for the year 1890-91.

The following is a statement of the number of rainguage stations from which data were received for publication in the Rainfall data of India at the end of the year :—

Province.	Number of stations.	Province.	Number of stations.
Burma	231	Baluchistan	84
Assam	126	Rajputana	176
Bengal	244	Central India	118
Bihar and Orissa	312	Central Provinces and Berar...	189
United Provinces... ...	276	Bombay and Sind ...	289
Punjab	192	Hyderabad	19
Kashmir	38	Mysore	77
North-West Frontier Province	33	Madras (including Pudukkotai, Coorg, Travancore and Cochin).	524

As stated in the last Administration Report a letter was addressed in January 1920 to most of the officers in charge of rainfall registration asking for more frequent inspections of raingauges ; it was suggested that they should

Madras Presidency of informing the district of the names of the stations which had not been of asking them to inspect as many of these as possible . The reports for 1920-21 showed a gratifying response er. This year's reports exhibit a further improvement in the of stations inspected in Bengal, Bihar and Orissa, Kashmir and yderabad. The percentage of inspections attained last year was maintained in all the other provinces with the single exception of the United Provinces ; where however the number of stations inspected this year was only two-thirds of that last year.

The following reports give a brief summary of the reports of the officers in charge of registration for the year 1921-22.

Burma.—There were 230 raingauge stations against 216 last year ; nine new stations were opened in the poorly represented Northern Shan States. Of the total 18 were meteorological observatories, 26 were in charge of the Public Works Department and 2 in charge of the Agricultural Department ; the rest were under district officers. The total number of raingauges inspected during the year was 178, and the inspections were satisfactory : of the stations inspected 144 were reported to be in good, the rest in fair condition.

Assám.—The number of stations inspected was 114 and the number of inspections 160 ; the corresponding figures last year were 117 and 173.

Bengal.—The number of stations inspected was 151 as against 114 the previous year and 78 in 1919-20. The number uninspected was 94.

Bihar and Orissa.—The Director of Agriculture states :

> " It is satisfactory to note that out of 285 stations 242 stations were inspected by Gazetted officers against 210 inspected last year. The number of inspections increased in most districts, but in Patna only 5 out of 17 gauges were inspected. Steps were taken to remove the defects disclosed by the inspection cards.
>
> Registration was neglected or inaccurately carried out at several stations in charge, for the most part, of minor police and post office officials. It is difficult to bring effective pressure on such agents in connection with a duty in which they have no interest whatever and the value of the statistics could probably be improved considerably by abandoning the registration at stations where the officer responsible proves incompetent, and having the fact recorded in his character roll."

United Provinces.—Out of 272 stations under the supervision of district and canal officers, only 43 per cent. were inspected, as compared with 67 per cent. in 1920-21.

Punjab.—115 stations were inspected by civil officers once or twice in the year. The gauges in charge of civil officers were all in good condition. No report regarding the number of gauges inspected was received from the Hoshiarpur District. The raingauges under canal officers were also reported to be in good order.

Kashmir.—The Meteorological Reporter states " Out of 39 stations, 8 are meteorological observatories and the remaining 31 are merely rain recording

stations. The number of inspections of raingauge stations made during the year was 14 against 8 of last year, which is satisfactory ".

The North-West Frontier Province.—The Revenue Commissioner writes that out of 36 gauges 28 were inspected during the year excluding two which were destroyed by enemy action during the Afghan War. A paragraph devoted to the subject in the Annual Report of Land Records and Agriculture for 1920-21 states :—" The remarks made in last year's report as to the necessity for inspecting at least 75 per cent. of the raingauge stations each year have been complied with, as all the raingauges in the province with the exception of a few were inspected by collectors and their assistants during the year under report ".

Baluchistan.—The Revenue Commissioner does not give the number of stations inspected, but writes " Raingauges in the Agency were regularly read by persons in charge and inspected occasionally by various officers ".

Bombay and Sind.—The Director of Agriculture writes :—

" It is very satisfactory to note that the work of inspection has been more satisfactory even than in the previous year in the case of the British districts. Out of a total of 278 gauges in the Presidency as many as 241 or nearly 87 per cent. were inspected during the year under report as against 226 or 82 per cent. during the last year. The total amount of inspection also shows an advance over the previous year, the total number of inspections during the year being 354 against 334 of the last year."

" With regard to the Native States it may be said that though the progress made in the last year has not been maintained during the year under report, the amount of inspection is in no way unsatisfactory. Out of a total of 61 gauges as many as 44 have been inspected or 72 per cent. It is hoped to make a decided improvement, by repeated reminders during the course of the current year."

Rajputana.—The triennial report from the Agent to the Governor General, Rajputana, shows that during the three years ending 31st March 1922, all the raingauge stations were inspected in all the states except Marwar and Jaipur ; in the former only 15 stations were inspected out of a total of 31 and in the latter 36 out of 49.

Central Provinces and Berar.—The number of inspections of raingauge stations in the Central Provinces during the year was 206 against 202 in the previous year and 179 in 1919-20. In Berar there were 64 inspections against 88 in the previous year. It is stated that the inspecting officers of the 11 districts (Saugor, Jubbulpore, Seoni, Narsinghpur, Hoshangabad, Betul, Chhindwara, Nagpur, Raipur, Amraoti and Yeotmal) had not made sufficient inspections in conformity with instructions contained in paragraph 10 of Revenue Book Circular III-2.

Hyderabad.—There are 17 raingauge stations under the Nizam's Public Works Department, of which 15 were inspected. In addition there is a raingauge in charge of the Residency Surgeon and one at Bolarum attached to the Indian Station Hospital.

Mysore.—Out of a total of 226 stations in the state 184 or 81 per cent. were inspected against 80 in 1920 ; 106 gauges were visited more than once.

Madras.—Out of the 492 rain recording stations 394 were in the Madras Presidency ; of these 361 or 92 per cent. were inspected. Of the 100 stations in the States 95 were inspected as against 82 last year. The Meteorologist, Madras, desires greater promptitude in the despatch of inspection reports, and with a view to economy in postage the invariable use of the inspection report cards instead of letters.

SUMMARY.

In Burma, Assam, Bihar and Orissa, the North-West Frontier Province, the Bombay Presidency, Hyderabad, Mysore and Madras, the proportion of rainfall stations inspected was over 75 per cent., which is satisfactory. In Bengal, the Punjab, and the Central Provinces, where between 50 and 75 per cent. of gauges were inspected, there is room for further improvement. But in the United Provinces and Kashmir, where less than 50 per cent. of stations were inspected, serious efforts should be made to increase the percentage of inspections.

SEISMOGRAPH OBSERVATIONS.

15. Seismological observations were recorded throughout the year by two Omori-Ewing seismographs at Simla and at Calcutta and one at Bombay ; by Milne seismographs at Kodaikanal ; and by means of other self-registering instruments at Colaba (Bombay). The data were transmitted to the Seismological Committee of the British Association.

TIME SIGNALS.

16. The observatories at Madras, Calcutta and Bombay determine time from star observations and communicate it to the local ports by time-ball signals. The distribution of time over the country generally is made from the Madras observatory by a signal transmitted daily at about 16 hours over the Indian telegraph system. A wireless time signal for the use of ships broadcasted twice daily at 1-30 and 13-30 G.M.T. from the Calcutta Radio station ; the signal is sent direct from the Alipore observatory by automatic apparatus. At Bombay the Telegraph Department have completed the line from the Colaba observatory to the Radio station, but the automatic apparatus for transmitting the signals has not yet been installed.

All the time work was performed satisfactorily during the year.

PUBLICATIONS.

17. There were no changes made, during the year in the form of the routine publications of the department, of which a description will be found in the departmental administration reports of 1907-08 and 1910-11. Publication of the Monthly Weather Review and of the Annual Summary, which had been stopped during the war, was actively resumed, and the issue for December 1918 had appeared by the end of the year.

The monthly and annual supplements to the Indian Daily Weather Report have been printed as usual, and supply the general need for prompt information.

As usual, the telegraphic weather summary was despatc
daily about noon and the weekly rainfall summary was supplie
of India and to press correspondents in Simla.

The amounts realised from subscribers during the year for
telegraphic weather summary was Rs. 5,023, while those received for the Ind
Bengal, Bombay and Madras Daily Weather Reports and for Weekly Weather and Crop telegrams totalled Rs. 6,993.

The amount debited to this department by the Post and Telegraph Department for the transmission of the daily telegraphic weather summary throughout India is about Rs. 5,000 a year, and includes provision for a number of Government officials to whom it is supplied free.

The following memoirs of the Indian Meteorological Department were published during the year :—

Volume XXII, Part VI, ' On dust-raising winds and descending currents,' by Dr. E. H. Hankin.

Volume XXII, Part VII, ' On dust-raising winds, by Dr. C. W. B. Normand.

Volume XXIII, Part I, ' Wet bulb temperatures and the thermodynamics of the air,' by Dr. C. W. B. Normand.

Volume XXIII, Part II, ' Correlation in seasonal variations of weather, VII, The local distribution of monsoon rainfall,' by Dr. Gilbert T. Walker.

Library.

18. The number of books and pamphlets, either purchased or presented by scientific bodies added to the library during the year was 688 as against 598 in the year 1920-21.

The work of classification based on the schedule of the International Catalogue of Scientific Literature, made fair progress, the current books and pamphlets being classified on receipt and the cataloguing of the old stock in the library being gradually carried on. Both subject and author card catalogue are being prepared. By the 31st of March 1922, 4709 books and pamphlets had been catalogued and card indexed.

Concluding Remarks.

19. The Meteorological Department owes a large part of its usefulness to the sympathetic assistance it receives from outside departments. Civil Surgeons and other officers of Government departments, as unpaid superintendents of observatories and in other capacities, help in the meteorological work ; the Telegraph and Postal Departments assist in every way in the rapid transmission of meteorological information, at the same time that they allow their employés to act as observers. The Indo-European Telegraph Department, also, by giving free transit to the daily records of the Persian observatories, places a large

.seful information at the disposal of the Meteorological Depart-
, telegrams were received from May to September from the Direc-
oyal Alfred Observatory, Mauritius, as well as from the departmental
.ries at Zanzibar and Seychelles. These telegrams gave valuable infor-
. of the weather conditions in the Indian Ocean and the department is
.ebted to the officers indicated for the punctual transmission of the informa-
.ion. Thanks are more specially due to the Director of the Royal Alfred Observatory for his courtesy in placing the meteorological data of that observatory at the disposal of the Indian Meteorological Department.

The department is greatly indebted for important information about meteorological conditions prevailing before and during the south-west monsoon to the Controller, Physical Department, Cairo ; the Directors of the Observatories at Buenos Ayres, Santiago and Batavia ; and to the various officers around the Indian frontiers who have collected and supplied valuable snowfall information.

GILBERT T. WALKER,

Director-General of Observatories.

SIMLA ;

The 25th September 1922.

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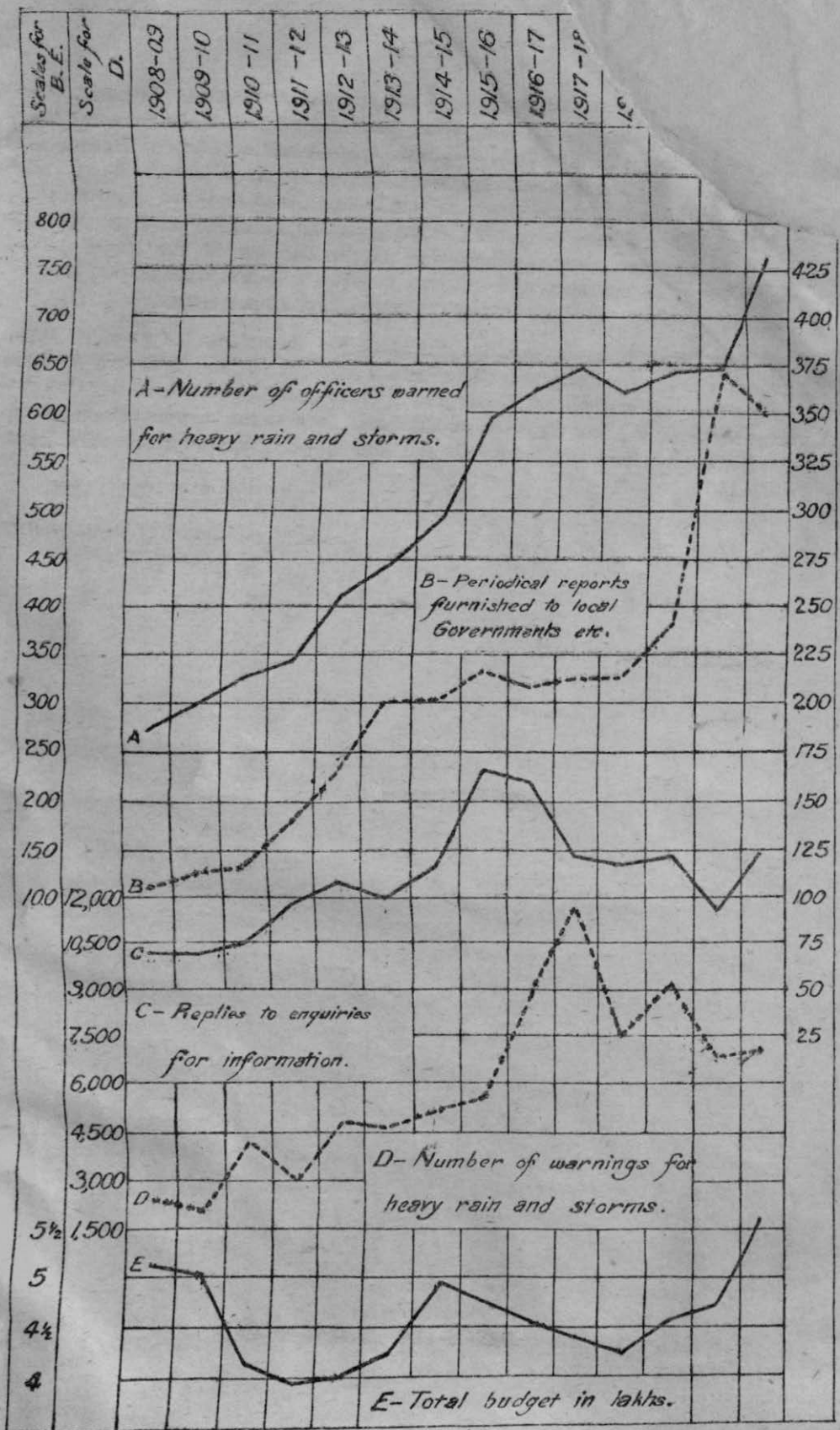
GROWTH IN ACTIVITY AI
Scales for B.E.
Scale for D.
1908-09
1909-10
1910-11
1911-12
1912-13
1913-14
1914-15
1915-16
1916-17
1917-18
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
425
400
375
350
325
300
275
250
225
200
175
150
125
100
75
50
25
A-Number of officers warned for heavy rain and storms.
B-Periodical reports furnished to local Governments etc.
C-Replies to enquiries for information.
D-Number of warnings for heavy rain and storms.
E-Total budget in lakhs.
A
B
C
D
E
12,000
10,500
9,000
7,500
6,000
4,500
3,000
1,500
5½
5
4½
4