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U. S. NAVAL TECHNICAL MISSION TO JAPAN
CARE OF FLEET POST OFFICE
SAN FRANCISCO, CALIFORNIA

5 January 1946

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From: Chief, Naval Technical Mission to Japan.
To : Chief of Naval Operations.

Subject: Target Report - Japanese Aerology.

Reference: (a) "Intelligence Targets Japan" (DNI) of 4 Sept. 1945.

1. Subject report, covering Target X-16 of Fascicle X-1, of reference (a), is submitted herewith.

2. The investigation of the target and the target report were accomplished by Captain Jerry H. Service, USNR, assisted by Lt. (jg) James R. Sanders, S(A), USNR, and Lieut. John Catt, RNVR, interpreter.

C. G. GRIMES
Captain, USN

RESTRICTED

X-16

JAPANESE AEROLOGY

"INTELLIGENCE TARGETS JAPAN" (DNI) OF 4 SEPT. 1945

FASCICLE X-1, TARGET X-16

JANUARY 1946

U.S. NAVAL TECHNICAL MISSION TO JAPAN

SUMMARY

MISCELLANEOUS TARGETS

JAPANESE AEROLOGY

The Japanese Army and Navy meteorological services have been demobilized. The new civilian organization under the supervision of the Air Weather Office of the Far Eastern Air Forces will become an integral part of the world weather service now in process of organization; conformity with the international code has been assured and the assignment of index numbers has been completed. By direction of SCAP, the General Central Meteorological Observatory and its district divisions are being restored by the Air Weather Office.

By 20 December 1945, the new organization and all of its observing stations were in operation, in spite of war damage to communications. Adequate meteorological personnel are available. In fact, the new organization can utilize the services of only about one-fourth of the personnel of the demobilized Army and Navy meteorological services. It is noteworthy that Japanese meteorological personnel, in contrast to United States meteorological personnel, includes comparatively few college graduates. The average forecaster is a high school graduate with a post-graduate course in meteorology sponsored by the Central Meteorological Observatory. However, it is believed that the Japanese forecasters use all available data to a very high degree of effectiveness. Their statistical analysis of data is more thorough than that of U.S. forecasters.

Synoptic data are collected by the use of direct lines from observation stations to district observatories, which are connected by direct lines to the Central Meteorological Observatory. The Central Meteorological Observatory issues short range forecasts for 36 to 48 hours, long range forecasts for 10 days (revised every four or five days) and 30 days, and seasonal forecasts for three months and six months. Air mass and frontal concepts are widely used, but the wave theory is not followed consistently because the Japanese have difficulty in detecting warm fronts in the vicinity of the home islands. Long range forecasts are predominantly statistical correlations, analogous charts, or interpolation. The Japanese call them "dynamic", but this designation would seem to be justified only by the selection of stations in accordance with average location of air mass boundaries. The Japanese state that their long range forecasting is in an experimental stage, and that all methods tried so far fail after four or five days. Research in forecasting in Japan is difficult to evaluate because it does not seem to be centralized and coordinated.

The Japanese apparently had little appreciation of the value of meteorology in chemical warfare. No chemical warfare training was given to any meteorologist of the Army or Navy; no meteorologist was assigned to the Chemical Warfare Section of either service.

Experiments were conducted on the transmission of weather maps by wire photo. The work was operationally unsuccessful, and the experiments were abandoned in July 1945.

No research had been undertaken either on rockets for carrying meteorological instruments to high levels, or on pressure instruments to be carried aboard submarines for measurement of atmospheric pressures at the surface.

One research project on long range forecasting was investigated thoroughly and is described in some detail in the body of this report.

TABLE OF CONTENTS

LIST OF ENCLOSURES

REFERENCES

A. Location of Target:

1. General Central Meteorological Observatory, TOKYO.
2. Chugoku District Central Meteorological Observatory, HIROSHIMA.
3. Japanese Naval Vessels in Kure Habor.

B. Japanese Personnel Interviewed:

1. Commander Masaaki BANDO, IJN, in charge of meteorological work (mostly charts and publication) after 1944, when that work was separated from the Japanese Hydrographic Office; demobilized 4 December 1945.
2. Commander Hisaya IIDA, IJN, successor to Commander BANDO; during the latter part of the war was in charge of the naval meteorological service.
3. Yoshio SUGAHARA, Director of Chugoku District Central Meteorological Observatory; formerly Director of Mishima Observatory - Fuji, San, Hakone.
4. Dr. Sakuhei FUJIWARA, Chief of Central Meteorological Observatory, TOKYO.
5. Dr. Y. NAKATA, Chief of Long Range Forecasting Section, Central Meteorological Observatory, TOKYO.
6. Dr. K. TAKAHASHI, Chief of Short Range Forecasting Section of Central Meteorological Observatory.

C. Related Report of Other Agencies:

1. "Scientific Intelligence Survey in Japan", September, October 1945 (5 volumes).
2. Interrogation Reports, U.S. Strategic Bombing Survey.
3. G-2, SCAP Accession Lists
4. Report of Air Weather Office of Far Eastern Air Forces to Army Air Force on Japanese Meteorology

INTRODUCTION

The objectives of this investigation were set forth in detail in instructions to the Mission. The first work of the investigating personnel was to ascertain whether any of these objectives were being covered by other U.S. intelligence agencies.

References (C-1), (C-2), and (C-3) were examined and interviews were conducted with personnel of the United States Strategic Bombing Survey, Air Technical Intelligence group, the Army Signal Corps, and the Air Weather Office of Far Eastern Air Forces. In this way were the objectives defined upon which NavTechJap personnel should focus their efforts. Results of the work on these objectives are reported here. Subjects within the scope of this investigation as originally planned, but which have been covered by FEAF, are listed in Enclosure (A).

THE REPORT

A. METEOROLOGICAL EQUIPMENT ON NAVAL VESSELS

Meteorological equipment carried in each type of vessel of the Japanese Navy was listed by Comdr. IIDA as follows:

	Battleship Aircraft Carrier	Cruiser	Mine-Layer Destroyer Escort	Torpedo Boat Gun Boat Submarine	Smaller Mine-Layer Sweeper
97 Type Wind Instrument	1	1	1	1	
Sea Type Pilot Balloon Computator	1	1			
97 Type Radio Sonde	1				
Sea Type Mercury Barometer	2	2	1	1	1
Thermo-Barometer	7	5	2	2	1
Aneroid Barometer	2	2	2	2	1
Max. & Min. Thermometer	1	1	1	1	1
Dry & Wet Thermometer	3	2	1	1	1
Standard Thermometer	21	12	5	4	3
Windmeter	2	2	1	1	1
Sea Surface Thermometer	2	2	2	2	1
Standard Hydrometer	1	1	1	1	1

Except for minor and expendable items, this list was verified by inspection of various types of Japanese naval vessels in Kure Harbor.

B. CHEMICAL WARFARE TRAINING OF METEOROLOGICAL OFFICERS

The Japanese apparently had little appreciation of the value of meteorology in chemical warfare. No chemical warfare training was given to Army or Navy meteorologists and no meteorologists were assigned to the Chemical Warfare Section of either service.

C. METEOROLOGICAL TRAINING OF ARMY & NAVY OFFICERS

Regular officers of the Japanese Army and Navy were given elementary courses in meteorology. Instruction periods varied from two weeks to three months. Prior to the war, each air pilot received approximately twenty hours of elementary instruction in aerology. During the war this instruction was omitted. Navigation officers of naval surface vessels were given a course of instruction of thirty hours duration in elementary meteorology.

D. USE OF RADIO-PHOTO OR FACSIMILE

Experiments on the transmission of weather maps by means of wire photo were conducted by the Japanese Navy at Kisarazu Air Field. The research was abandoned in July 1945 for the following reasons:

1. Maps were not sufficiently detailed for interpretation by inexperienced personnel.

2. Experienced meteorological personnel could construct better maps for themselves than the wire-photo maps.

3. The transmission time, 15 minutes, was too great.

E. USE OF ROCKETS

As far as could be determined, the Japanese made no use of rockets, operationally or experimentally, for carrying meterological instruments to high levels.

F. BAROMETERS FOR SUBMARINES

No pressure instruments for measuring surface atmospheric pressure and suitable for carrying aboard submarines were developed by the Japanese, nor had they conducted research work on such instruments.

The instrument list in Part A shows that one mercurial barometer was allowed each submarine. A 1922 model aneroid barometer, which was on the Submarine I-155, differed from our ordinary aneroid barometer only in its greater range, 70cm to 89cm.

G. ENCIPHERING WEATHER INFORMATION

Efforts to obtain information on Japanese methods of enciphering weather information, their instruction books, code books, tables, etc., were completely unsuccessful. There was no indication that this failure was due to lack of cooperation on the part of Japanese personnel interrogated.

H. CONSTRUCTION OF SYNOPTIC CHARTS

Synoptic data are collected by the use of direct lines from the observation stations to the district observatories, which are in turn connected by direct lines to the Central Meteorological Observatory. Surface data are plotted on charts of such small scale that several sheets are required to avoid confusion of symbols at the stations. Special charts plotted are topographic charts; hemisphere maps; departure charts (showing anomalies of pressure, temperature, and relative humidity distribution from the five-day mean, 24 hour pressure and dewpoint changes and maximum and minimum temperatures); and upper air charts of the 850, 700, and 500 millibar surfaces, and of changes in heights of 700 and 500 millibar surfaces.

The upper air diagrams in use are Roosby's, and the Taiki diagram. The Taiki

diagram, according to its inventor, YAMAOKA, has two distinct advantages: (1) the normal lapse rate of 0.5 degree Centigrade per 100 meters is almost a vertical line; and (2) height differences may be computed directly from it.

I. HIROSHIMA LONG RANGE FORECASTING RESEARCH

Early in 1944, to assist agriculture and to provide bases for food supplies in the CHUGOKU District, Tadasuke HIRANO, Director of the Chugoku District Central Meteorological Observatory, HIROSHIMA, began a research on long range forecasting of rainfall and temperature of HIROSHIMA. He based his forecasts upon data recorded at HIROSHIMA and at various Asiatic stations during the period 1904-1944. For example, from atmospheric pressures recorded in January 1945 at DAIREN (Manchuria), NAHA (Okinawa), and NEMURO (Hokkaido), he would (on the basis of the statistics of 40 years or so) forecast the rainfall in HIROSHIMA in January 1946. The statistical analysis seemed to be well done and the selection of stations appeared to be in accord with air mass locations. The work is not complete, hence it has not been properly tested.

The weather of HIROSHIMA is determined by three types of air masses, denoted as Pc, Pm, and Tm (Em); that is, polar continental, polar marine, and tropical (equatorial) marine. Conditions at DAIREN, NEMURO, and NAHA are assumed to be typical of the respective air masses.

The values of pressure and temperature for a given day were the averages of the 0600 and 1400 values. Monthly means were computed for the three stations above mentioned, and monthly totals of rainfall at HIROSHIMA for the forty-one years 1904 to 1944 inclusive. From that point on, the computations were carried out as one complete research for each of the twelve calendar months. In the following paragraph, the procedure for the month of January will be outlined by way of illustration.

Pmax and Pmin were the greatest and least (for some reason HIRANO actually used next-to-greatest and next-to-least) monthly mean pressure values at DAIREN, let us say, for any of forty-one Januaries. For a given year, P was the monthly (January) mean pressure at DAIREN, for example. For a given station and year, P was the percent quotient P minus P min, divided by P max - P min. ΣP for a given year was the sum of the P's for DAIREN, NAHA, and NEMURO. For a given station and year, a quantity Q was computed, equal to the percent quotient P divided by ΣP. From the definition of ΣP, it is evident that Q DAIREN plus Q NAHA plus Q NEMURO equals 100.

For example, for January 1905, for DAIREN, NEMURO, and NAHA, respectively, the P's were 69, 49, and 48. The ΣP was thus 166, and the respective Q's were 42, 29, 29, which are seen to total 100.

For a given calendar month (January) a triangular diagram (see Enclosure (B)) is prepared, with the three sides labelled respectively NAHA, DAIREN, and NEMURO, starting at the bottom and continuing clockwise. For any one year, 1905 for example, the three Q's (for January) are plotted from the respective sides perpendicularly. Since the Q's total 100, the result is a point. In this manner, on the January sheet are plotted the forty-one points for the years 1904 to 1944 inclusive. Enclosure (B) is a sample blank triangular diagram with the sides labelled and the 1905 point plotted with the values as given in the preceding paragraph. To summarize, when the whole research is complete, the result will be twelve sheets (one for each calendar month) with forty-one points (one for each of the years 1904 to 1944, incl.) plotted on each.

The objective is to forecast rainfall at HIROSHIMA for a given calendar month and year, from the pressures at the three stations (NAHA, DAIREN, and NEMURO) during that calendar month in the preceding year (for example, the rainfall in January 1946 from the pressures at the three stations in January 1945). Hence, the next step is to write alongside each plotted point the total rainfall at HIROSHIMA during the succeeding year (for example, on the January

sheet, alongside the 1905 point write the total rainfall at HIROSHIMA in millimeters in January 1906). Then isohyets curves of equal rainfall) are drawn for 30mm intervals beginning at 50mm.

The January diagram, as an illustration, will be used as follows: At the end of January 1948, for example, the 1948 pressure point will be plotted. Let us suppose that it falls among the isohyets at 97mm, Then the forecasted(one year in advance) total rainfall at HIROSHIMA for January 1949 will be 97mm.

As already stated, the computations and the preparation of the twelve triangular diagrams have not been completed. Hence, the reliability of the method has not been tested. However, in a process of this kind regularity of (in this case) the isohyetal pattern is to some extent a measure of the correlation. It must be stated that in this research many of the diagrams show pronounced irregularity of isohyetal pattern.

The process for forecasting monthly mean temperature at HIROSHIMA one year in advance is exactly similar to that for forecasting monthly total rainfall one year in advance.

HIRANO also began researches using five-day means, with forecast lag not yet decided upon.

All of the records seized at HIROSHIMA pertaining to HIRANO's work were returned, after study, to the Central Meteorological Observatory in order that HIRANO might be able to continue his work.

ENCLOSURE (A)

LIST OF SUBJECTS PERTAINING TO JAPANESE AEROLOGY AND METEOROLOGICAL INSTRUMENTS INVESTIGATED BY FEAF

1. Organization of the Japanese State Meteorological Service: Name, index number, position coordinates of weather reporting stations.

2. Routine weather reports normally made by each station: Times, form of report, method of transmission and collection.

3. Where reports are collected and analyzed; what forecasts are issued, to whom issued, how disseminated.

4. Personalities and location of principal meteorological officials and recognized authorities.

5. The trained meteorological personnel that are available to man observing stations and to assume supervisory capacity over the existing organization.

6. Samples of Japanese weather messages, weather charts, and forecasts.

7. Meteorological equipment available at the various stations and forecasting centers.

8. Organization of Japanese Army and Navy meteorological services. Relationship to State Meteorological Service. Size of Army and Navy meteorological organizations, types of individual units, where assigned.

9. Scope of meteorological information available to Naval and Military commands, methods of dissemination.

10. Personalities and location of principal meteorological personnel (Navy, Army).

11. Trained meteorological personnel (Navy, Army) available to man observing stations (Navy, Army) and to assume supervisory capacity over existing organization.

12. Observing stations that are normally manned by military or naval personnel. Name, index number, coordinates of each station.

13. Information regarding weather reconnaissance flights made by aircraft, how frequently, and in what areas.

14. The status of long range forecasting. Periods of time for which long range forecasting is made and have made their success.

15. Special provisions the Japanese have for the dissemination of typhoon warnings.

16. Developments that have been made in research on upper air soundings for winds and densities, using electronic aids.

17. Copies of available technical publications concerning meteorology.

18. Theory, data, and instruments related to precipitation and atmospheric electricity.

19. Meteorological instruments of any type not common in the United States.

ENCLOSURE (B)

TRIANGULAR DIAGRAM LONG RANGE FORECASTING