OTS: 60-11,524

JPRS: 2535

19 April 1960

DEVELOPMENT OF METEOROLOGICAL RESEARCH IN CHINA IN THE PAST DECADE

- COMMUNIST CHINA -

By Chao Chiu-chang

Distributed by:

OFFICE OF TECHNICAL SERVICES
U. S. DEPARTMENT OF COMMERCE
WASHINGTON 25, D. C.

Price: $0.50

U. S. JOINT PUBLICATIONS RESEARCH SERVICE
205 EAST 42nd STREET, SUITE 300
NEW YORK 17, N. Y.

JPRS: 2535

CSO: 3350-N/C

DEVELOPMENT OF METEOROLOGICAL RESEARCH IN CHINA IN THE PAST DECADE

[The following is a full translation of an article written by Chao Chiu-chang, member of the Geophysics Institute, Academia Sinica, in Ch'i-hsiang Hsueh-pao (Journal of Meteorology), Peiping, Volume XXX, No 3, Pages 206-211.]

Under the correct leadership of the Communist Party in the past decade, the people of China have bravely marched forward toward socialism. This decade has also marked the rapid development of meteorology.

Before liberation, meteorological projects directed by Chu K'o-chen had been struggling for survival for over twenty years and were barely able to establish a foundation. Since the reactionary government did not emphasize science, meteorology was separated from the masses; hence, despite the efforts of certain scientists, its development was limited. On the eve of liberation, China had neither an adequate observatory nor a complete system of meteorological services. There were only a few dozen meteorological researchers in the whole country, and in a twenty-year period only some 400 research papers were published.

In 1955, Chu K'o-chen had already correctly evaluated the general development of meteorological research in Old China in his preface to a more recent Chinese scientific mass of publications--Meteorology [title of collection?]. We had a limited understanding of the weather areas of China; we conducted some researches in the sudden occurrence of the cold wave in Asia, the characteristics of the Formosa typhoon, weather patterns, and analyses of the air mass.

In addition, we carried out researches in atmospheric circulation and in meteorological dynamics. In general, the direction of researches was separated from [the needs of] production, and the 400 publications showed few signs of

creativity. Sinde research methods were confined to descriptions of past experiences, progress in weather analysis of physical processes as causes of weather development was deficient. All observational instruments and equipment were imported from foreign counties. The experimental technique of utilizing the recent achievements of mddern physics for observing meteorological development practically did not exist.

After liberation, under the leadership of the Communist Party, and in pace with national defense and economic construction, meteorology in China reached a new stage. At the beginning, through the education of the intellectuals by the Party and the movement of self-rectification, the majority of the meteorology workers supported the Party's policy of combining theory and practice, as well as the policy of science for production.

Since then, all the scientific research units, universities, and various meteorological services have been cooperating to work closely as a single team. In laying a solid foundation, establishing observatories and observation stations, educating staffs, learning from the USSR, and initiating daily services for those research works which gave due consideration to the actual meteorological situation in China, the meteorological enterprise in China completely changed its appearance.

In 1955, meteorological researches in China began [a program of] over-all development. In obtaining statistical data and in defining meteorological areas, meteorology has established its foundation; in agricultural meteorology, surveys of a synthetic nature--a joint project for the exploration of tropical natural resources--have commenced.

In the first half of 1956, over 300 specialists, under the leadership of the State Council and the Central Committee of the Chinese Communist Party, together with 18 academicians, professors, and physicians from the Soviet Union, formulated a twelve-year scientific plan for China. The development of the meteorological enterprise was considered to be one of the most important scientific and technological tasks of the nation.

For completing such a task, on the basis of reviewing the advanced international levels [of research] and the present situation of China, resolutions were made on certain

central problems of science, on taking concrete measures, and on stages of progress and staff education plans. Thus the development of the science of meteorology was included as an important service for the construction of socialism. This provided a great future for all the meteorological workers of the whole nation.

Moreover, this period also was a critical stage in the development of the science of meteorology of China. Thereafter, under the leadership of the national scientific staff, research and education units of meteorology of the country gradually permitted research projects to be assimilated within the over-all [program of] national planning. After two years of practical efforts, the projects of meteorological researchers were properly oriented.

In 1958, on the basis of the anti-rightist movement, the nation started the historically unprecedented leap forward movement. To meet the needs of the rapid scientific development of industry and agriculture, meteorology in China simultaneously reached its leap forward stage. Based on general and regional forecasts together with a consideration of topographic characteristics, weather, climatic laws, and experiences of the masses, stations of Chenhsiung, Yunnan Province, initiated the supplementary forecasting procedure, which later was popularized throughout the nation. This system increases the degree of accuracy of weather forecasting. This is a creative achievement of production, under the leadership of the Party, which was made possible by cooperation between the meteorologists and the masses.

Moreover, in pace with the national leap forward movement, all other scientific research organizations have also been developing rapidly. Graphical long-range weather forecasting has been undergoing a new development. Completion of the project to alter the climate of the northwest drought area, completion of the project to melt the snows of Chi Lien Mountain, as well as the successful achievement of artificial rain, were advanced on schedule. Practical problems, which also were highly theoretical in nature, were dealt with in researches.

A summary of the achievement of meteorology in China during the past decade may be outlined as follows:

1. Climatology

Conforming to the policy of "combining climatic analysis with the climatic reality of China," Chinese meteorologists have developed a system of analysis methods which is applicable to the plateau area of West China and have discovered the characteristics of the frontal region and vortex movement in China. They have also criticized the over-simplified climatic analysis method taught by the Norwegian school. By means of a number of researches, we obtained a more systematic understanding of the physical processes and statistical characteristics of the main climatic systems of Asia. All these successes were made possible only by the rapid development of weather forecast services, which play an important role in increasing the accuracy of weather forecasting in China.

The most urgent problem in weather forecast services is emergency weather forecasting. The emphasis of researches by the meteorological workers has been placed on subjects such as the cold wave, frost, Formosa typhoon and storms. Many researches begin with a study of changes in general circulation and weather processes, and then on the basis of statistical analysis, tackle the problems of the sudden occurrence of a cold wave, and of rain caused by cold air. These researches have their practical significance in cold wave forecasting.

On the other hand, researches were centered on summer precipitation forecasting. In June and July 1954, both the Yangtze River and Huai River Valleys suffered from the most damaging flood of this century; in the summer of 1956, a flood of the Sungari River caused colossal damage to property and losses of lives. To help control the flood and regulate water courses, meteorologists of China began to emphasize researches in precipitation forecasting soon after liberation.

In all these researches, topics such as the movement of precipitation areas, thunderstorm and cold air activities in North China, cold fronts, blocking high pressures and cold vortices, monsoons and low hot pressure areas, warm fronts and the Formosa weather system, and the relationship between over-all Pacific Ocean weather conditions and precipitation in China were discussed. Many articles deal with characteristics of storms and precipitation processes of the rainy season of June and July in the middle and lower stream

area of the Yangtze River, while others discuss research on the results of the activities of air masses. On the basis of such works, the foundation of summer precipitation forecasting was laid in 1953. This is highly significant in helping practical production.

Since the Formosa typhoon has caused significant damage to the southeastern coast of China, meteorologists have greatly emphasized studies of its activities. Among large-scale researches, there have been discussions on the movement and courses of the Formosa typhoon, the relationship between the activities of the Formosa typhoon and general circulation, the cause of the Formosa typhoon, the statistical law of its activity, its structure and the analytical method of conducting research on it. Other researches include the study of frost, hurricanes, and hail. All these works created conditions for increasing the degree of accuracy in weather forecasts.

In aeronautical meteorology, experiences and data have been obtained concerning traces of frost, forecasts of visibility, analysis of rapid circulation at high altitudes in China, icing conditions, and the topography of plateaus. Various theories dealing with these topics have been studied.

2. Long-Range and Medium-Range Weather Forecasting

The level of short-range weather forecasting in China has been rapidly raised. It has played an important role in assuring the completion of all construction tasks of the national economy. But the one-to-two-day forecasts cannot satisfy the needs of all branches of industry. For this reason, long-range and medium-range weather forecasts have gradually become the daily work of the meteorologists.

Systematic researches have been carried out to learn the methods of long-range and medium-range weather forecasting employed in the Soviet Union. The results are as follows: the existence of the natural periodicity of weather in Asia has been ascertained; it was pointed out that the natural period of weather in Asia is shorter than in Europe and that the weather movement system in Asia is greater in number than in Europe; a basis was established to define division of natural weather areas; [it was found that] the weather processes of various natural weather areas are subject to changes

according to seasonal change; the process of cold wave occurrence has been analyzed and its axis has been computed; data on the distribution of precipitation during the natural summer period in China have been obtained, and principles of the forecast of precipitation periods have been established. On the basis of all the above researches, medium-range weather forecast services have been organized by various meteorological departments.

Some researches were made in connection with long-range forecasting soon after liberation. Correlations between the form of general circulation, distribution of the temperature of sea water, and serious flood and drought in the past were studied. Though all these researches are required for long-range forecasts, they are insufficient for establishing the long-range forecast services.

Thereafter, from the data obtained in past years, meteorologists derived the statistical characteristics of the historical changes of meteorological elements, on the basis of which the mean value monthly forecast program was suggested one year in advance. The degree of accuracy of forecasts on tendencies was about 75 percent; these were valuable as guides for agricultural and water conservation services. However, no data were supplied for an understanding of either the weather process and development or the cause and effect relationship.

Moreover, based on the "Rortanovski" theory of the Soviet Union, some meteorologists started from the classification of the period of natural weather condition of Asia to obtain the periodicity and rhythm of various classifications and the relationship between different stages of development. On such a basis, the quarterly forecasting of the development of natural weather periods was suggested. The Central Meteorological Research Institute has adopted this method for publishing quarterly forecasts. Results are to be evaluated.

Based on the great leap forward movement of 1958, meteorological stations, observatories, and research organizations throughout the nation began research in medium-range forecasts. In regard to local climatic data, climatic charts, and experiences of the working masses, meteorologists suggested a few methods for medium-and long-range forecasts. In October 1958, the Central Meteorological Bureau called the Lanchow Conference, during which a good foundation was laid for improving the results of medium- and long-range

forecasting in the future. In 1959, ten-day and six-month forecasts were tried, and the results have yet to be evaluated. A revision of the method will be made after the evaluation [has been completed].

3. Numerical Weather Forecasting

Based on an understanding of the characteristics of various regions and the physical processes of weather development, the numerical integration of weather equations is a necessary course in weather forecasting, which will take us from the stage of [gathering] experience and qualitative analysis to the stage of objective quantitative analysis. After the establishment of the foundation of all weather forecast services, and of weather stations and observatories, it is very necessary for the meteorologists of China to opporturely direct their attention to this area.

At the beginning, the correction of heat-driven winds was considered. The Fjörtoft method was modified into a two-layer model graphical method, which was applied to short-range and 48-hour range forecasts of cold waves. Moreover, researches have been made to analyze the accuracy of using the method of finite differences to solve Poisson's equation, to apply the graphical method of the three-layer modesl, to find out the principles of determining the qualities of three-parameter models, and [to aid] numerical precipitation forecasting.

Because of the topographic complexity of China, it is necessary to consider natural influences in numerical forecasts. At an early stage, barotropic models were used to calculate the development tendency caused by topographic conditions. Later, researches were made on topographic influences under baroclinic conditions, as well as to solve Green's function for numerical forecasts. In medium-and long-range forecasts, consideration must be given to the eddy transport term, mainly because it cannot be neglected. Moreover, consideration of the eddy transport term helps to reduce the vorticity filed--and hence increases the stability of the calculation of the model. In recent researches, in connection with medium- and long-range linear and nonlinear models, a geostrophic baroclinic model was been suggested to study solar radiation. Since historical data have not been utilized in numerical forecasts, the utilization of

historical data to increase the accuracy of numerical forecasts has been suggested.

4. General Circulation

The development of the weather system is the main object of study in weather forecasting; it is also one of the component of general circulation. The study of general circulation is highly important both for weather services and as a supplement of basic theory. Since liberation, the great amount of meteorological data on the atmosphere and on high altitude regions enabled us to clarify the structure of the general circulation of Asia by using high-altitude surface isobaric and vertical cross-sectional charts. There are two currents of rapid flow of high altitudes during the winter in Asia. The southward stream of rapid flow appears and vanishes quite suddenly during seasonal changes. It shows the nonlinear character of the dynamic structure of the general circulation. These abrupt seasonal changes control the sequence of development of the medium-and long-range weather processes--a phenomenon which may be useful for medium- and long-range weather forecasts.

The Tibetan Plateau is the greatest obstacle on the surface of the earth. It exerts a great influence on the climate and weather of China, and even on the general circulation of the whole Northern Hemisphere. During the past decade China has conducted numerous researches on plateaus and has achieved great success. The recently published "Meteorology of the Tibetan Plateau" sums up researches on the influence of the Tibetan Plateau on general circulation. The results of these researches not only have academic value but practical significance as well.

As far as the basic theories are concerned, the following are the successful results: first, by considering the actual topographic conditions and the heat field, we have obtained the solution of the baroclinic general circulation equation on whose basis we have calculated the January and July 500 m.b. mean value tendency chart of Europe, Asia, and the Western Hemisphere; secondly, we have studied the physical atmospheric quantities, such as the equilibrium of angular momentum, and thermal potential and quantity (in regard to the equilibrium of angular momentum, the mean meridional circulation has been

verified by actual records, particularly in reference to the low latitude Hadley circulation effect [Hadley Ring]); and thirdly, concerning the aperiodic development of the atmosphere, we have proved, from calculations of the physical quantities of a few actual observations, that during the process of large-scale development, the direction of potential transformation and the direction of heat transfer are opposite to each other during the period of low index circulation and high index circulation--a finding which helps us significantly in understanding the equilibrium of general circulation. "Some Basic Problems of General Circulation" is the title of the work in which we published a systematic summary of the results of our researches.

Finally, we have recently conducted over-all research in seasonal changes of general circulation, and we have ascertained the quasi-constancy of the west wind index and the annual north-south exchange index; we have also discovered the regularity of atmospheric pressure fields of various critical areas. This gives us a new understanding of the intrinsic properties of the seasonal changes of general circulation.

5. Climatology

Since liberation, the rapid development of the economic construction of socialism has expedited researches in climate in China. Climate is one of the many factors to be considered in various fields of construction. The demand for climatological data, climatic charts, and climatological researches on the part of various production departments has steadily increased. In the first few years of national construction, a great effort was exerted to collect and arrange climatic data and to compile climatic charts; at the same time various researches were carried out in problems of climatology on the basis of newly collected data.

In summary, the achievements of climatology in China are as follows:

1. Compilation of new climatic charts which are necessary for various production units, and which supply indispensable data for climatic researches;

2. Climatic analysis in connection with capital construction (we have a great amount of research material on the analysis of thunderstorms and characteristics of the climate of various areas and river vallyes, and climatic characteristics have been prepared by almost every province);

3. Definition of climatic areas, which include the more carefully defined second- and third-class climatic areas;

4. Researches in monsoons (works in this connection have been numerous since liberation; a part of the works help to clarify the characteristics of the monsoons of Asia, while another part of the works aid in the understanding of the characteristics of the general circulation of Asia under topographical influences) a kind of research closely related to researches in general circulation;

5. Problems concerning climate formation, including problems, such as the equilibrium of heat and humidity, which are closely related to the formation of climate.

6. Agricultural Meteorology

Many researches have been conducted on climatic adjustment problems created by seed introduction of certain industrial crops into South China. For achieving small-scale weather control, work on forest preservation was suggested. Investigations were made on the choice of localities suitable for afforestation, and on the topographical conditions which affect northward movement of climate. Various agricultural meteorological observation regulations were drafted. The temperature indices of the growth period of rice, wheat, cotton, soybeans and rape were established, and researches was conducted to predict their main preiod of growth and the harvesting time. Through small-scale climatic observations, it was proved that agricultural techniques inherited from our ancestors, such as the "freezing flow" method, wind prevention devices, early spring tillage, and soil pressing may increase the benefits obtained from meteorological measures. Moreover, researches have also been carried out in regard to emergency measures for protecting crops from damage caused by weather of a destructive nature. As far as agricultural climatology is concerned, many provinces have specified their agricultural climatic areas.

7. Atmospheric Physics

During the International Geophysical Year, we began to study ozone and we provided the conditions for the observation of the aurora at night, spectra of lightning, and the generated gas spectrum. Concerning atmospheric physics at the lower layer near the surface of the earth, theoretical calculations were made on the characteristic distributions of meteorological elements of this atmospheric layer. Theories were applied to the understanding of the movement of sand driven by wind in Northwest China; a certain degree of success was achieved. Work has been done in determining the coefficients of eddy transport at the higher and lower layers. The scaling method has been used to measure evaporation of several reservoirs. Observations have been carried out on radiation equilibrium after dark in the glacier area of Chi Lien Mountain. Both actual observations and theoretical research were performed on perpendicular visibility.

Besides, one should cite the development of artificial rain and the physics of clouds and fogs. This item of work is a practical successful achievement of the great leap forward movement. Bold in both action and imagination, we achieved success in experimental artificial rain in Kirin Province. Experiments were also carried out in the provinces of Kansu, Hopei, Wuhan, Anhwei and Kiangsi. Two cloud and fog stations were built on high mountains. This is a fine beginning for our work on artificial rain in China.

Looking back on the development of meteorological researches in China during the past ten years, we consider the following to deserve special mention:

(a) During the past decade the most salient characteristic of meteorological research in China is its close coordination with the national economy. Though meteorologists in China have been directing their attention toward the progress of world meteorology, we do not blindly follow the main course of international meteorological research. The objective of our research is to solve the important meteorological problems which are related to the construction of socialism.

Our meteorology, therefore, was born out of, and is nurtured on, the soil of our mother country. We shall expand

as the meteorology school of China. More precisely, the cause for the rapid growth of meteorology in China is the determination of meteorological workers to support the policy of the Communist Party--namely, "the inseparability of science, and the combination of theory and practice."

Soon after liberation, we considered it necessary, above all, to establish the meteorological services of New China; on the basis of their establishment we developed our researches. During that period, the research organizations devoted most of their time and energy to the establishment of the centralized data department and the joint weather forecast analysis center. Most of our problems were generated by our actual meteorological services and by further developments in the future. Solutions of these problems not only help to advance the development of our meteorology but also raise the level of our meteorological sciences and establish the foundation of our meteorological researches. In the past ten years most of our meteorological researches began with the theoretical solution of practical problems, and the solutions of these practical problems provided, in turn, new directions for theoretical research. Further scientific development may be determinèd by various objective conditions, but the principle of combining theory with practice will not change.

(b) In 1953 the Central Meteorological Bureau and the Academia Sinica determined separately their five-year plans; in 1956 they adopted another twelve-year plan of science for future development, so that meteorology in China would be correctly oriented toward the construction of socialism. On the basis of the scientific planning of meteorological services, education and research have been combined into an organic whole. By mobilizing all possible efforts we have been able to guarantee the completion of the most urgent tasks and to arrange schedules for long-range basic theoretical developments. This cannot be separated from the leadership of the Communist Party. It is impossible to achieve the coordination between scientific development and the national economic plan without the leadership of the Party.

(c) Mobilization of the broad masses is the motivating force of meteorology in China. During the great leap forward movement of agriculture and industry last year, meteorological conditions were critical factors which guaranteed the possibility of high rate production over vast areas. The

masses were required to learn meteorology, and meteorology certainly helped to solve some of the people's problems. Recently almost every commune has formed its own meteorological worker and "sky watching" group. In this way the production activities of millions of the working masses are closely connected with meteorological work.

Last year, supplementary local weather control were strongly supported by the masses. Such a rapid development and successful achievement was not possible without the guidance of the general direction of the Party, the call of the great leap forward movement, and the ideology of the mass direction of the Party. This fact has crushed the cynicism that the rightist opportunists directed toward the leap forward movement.

(d) Meteorology is a science which is related to the national economy. For coordinating the large-scale construction of socialism, we must promote all kinds of researches. First by referring to the experiences of the masses and to local features and based on careful analysis of systemized data, we have ascertained the climatic characteristics of various areas and can therefore fully utilize the meteorological data of our country. This is a complicated task. To complete such a task, it is necessary to have an overall plan and a long-range program, and to encourage the positive attitude of various organizations and meteorological societies. Secondly, the development of modern meteorology is inseparable from the recent discoveries of physics. In the past decade, however, we have not completely established a system which utilizes the modern experimental technique to study the macroscopic meteorological process. Without such a method, the development of meteorology in China will become uni-dimensional. Therefore, our future development should emphasize the establishment of such a new methodology. Thirdly, in the past we did a great deal of work on the description of general weather observations, which has contributed significantly to our national economic construction.

In the future we should continue our effort to discover the physical characteristics of large-, medium-, and small-scale weather processes, and to employ these principles so that the accuracy of weather forecasts can be increased and the long-range forecasting of weather of a destructive nature can be accurately determined. This is our current task and the direction of our effort.

However, the general trend of meteorology is connected with physics and new techniques. Therefore, through theoretical researches, experiments with models, and methods of weather analysis, we shall progress further and discover the physical mechanism of weather development. By using modern new techniques to study the macroscopic process of the physical properties of cloud and fog, we shall ascertain the principles of natural precipitation. This is the important direction of our meteorological researches of the future.

2065

- END -

This publication was prepared under contract to the
UNITED STATES JOINT PUBLICATIONS RESEARCH SERVICE,
a federal government organization established
to service the translation and research needs
of the various government departments.