

A STUDY ON THE TYPHOON MODEL (1)
— ON THE SIMULATION MODEL AND
GAME OF THE TYPHOON —
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1. INTRODUCTION

In Japan, materials of hundred milliard yen that is equivalent to 20—30% of the national budget are deprived by storms, floods, earthquakes, tidal waves and fires, etc. every year.

Particularly the damages owing to the typhoons are the biggest. It is pointed out by K. Takahashi^{(1)*} that the average amount of damages owing to natural calamities is increasing year by year, and that the countermeasures to prevent disasters will become more effective.

From the viewpoint of serving the customers of our electric company, the problem to prevent disasters owing to typhoons will become increasingly important in the future.

In September 1959, the violent Isewan typhoon passed through the Chubu district and deprived several thousand people of the lives and materials of hundred milliard yen.

From that time on, the subject of preventing typhoon' disasters greatly excited our interest. The O. R. group in the Planning Department of the Chubu Electric Company began to study the prevention of typhoon disasters from the viewpoint of operational research from July 1960.

The purpose of this report is to describe the scope of our research and to present a part of the results of computation with regard to the typhoon model.

2. OPERATIONAL RESEARCH ON TYPHOON DISASTERS

The disasters owing to a typhoon consist of the destruction of structures, namely houses, electric power stations, transmission facilities,

* The number is No. of References.

etc. When the destruction power f acts on some structure, whose strength F is greater than f , there can be no damages.

However the requirement $f < F$ for every facility toward every destruction power is uneconomical. There are following ways to prevent the typhoon disasters, leaving out of consideration the possibility or impossibility of them.

- i) To prevent the attack of the typhoon.
- ii) To avoid the destruction power of the typhoon.
- iii) To strengthen the facilities.
- iv) To minimize the damages.
- v) To shorten the repair-time and minimize the loss due to damages.

Among these ways, i) is impossible at present, and ii) is possible for ships that can shift themselves, but impossible for the facilities of our electric company.

Concerning iii), we must consider the economical limitation in relation f and F .

And iv) and v) are the most passive ways, but at present our means for prevention of the typhoon disasters are limited to them.

Therefore we picked up the following problems in this research,

- a) Prediction of the typhoon disasters,
- b) Game of the typhoon,
- c) Economical strength of the electric facilities against the wind.

There are three mainly types of destruction power, namely due to strong wind, heavy rain, and highest-flood-tide.

As the wind is related to rain and highest-flood-tide, and is the most important item, we must discuss this problem in the first place. Since the problem of the highest-flood-tide was studied at the Meteorological Agency, we left out this problem. And the problem of rain is more difficult than that of wind, but we will study this problem next to wind as quickly as we can. Therefore in what follows the above-mentioned problems a)~c) are discussed mainly from the viewpoint of the wind in the typhoon model.

But, when we estimate the economical strength of facilities, it is necessary to include the items of rain and the highest-flood-tide, so we will use a suitable approximation for the time being.

2. 1 Prediction of the typhoon disasters

It is very useful to predict the wind velocity, the rainfall and the resultant damages, several hours before the typhoon attacks. For example, in our electric company, by making arrangements of materials, workers, cars and so on according to the prediction, we can begin the repair-works soon after the passage of the typhoon.

Up to this time we were used to making arrangements by the reports from the actual places, but it took much time to get the informations as shown in Fig 1 (Fig 1 is the case of the Isewan typhoon).

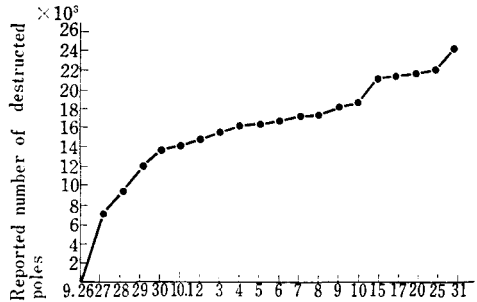


Fig. 1

If we can predict the damages beforehand, it will be possible to prevent the delay in the preparation of workers and materials caused by spending them to no purpose, and even prevent the damages themselves.

The merits of prediction depend on the accuracy of prediction, the costs for prevention of the damages and the amount of damages.

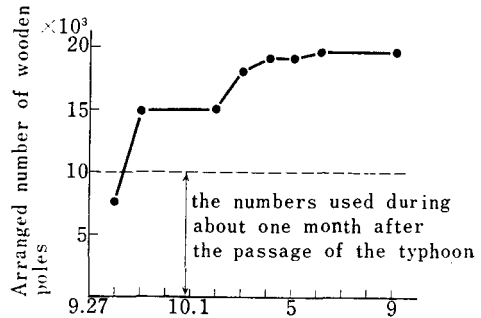


Fig. 2

First of all we must make use of the typhoon forecast announced by the meteorological observatory. It is said that recently the probability of the success the typhoon forecast at the Meteorological Agency is about 83% and is being improved year by year.

Thus the reliability of the typhoon forecast will become considerably high in the future and in practice it will be useful for our purpose.

Therefore if we can simulate the destruction power of the typhoon that passes the course forecasted, the prediction of damages is possible. For example Fig 3 and Fig 4 show the relation between the

wind velocity and the fall-down rate, which is approximately proportional to the square of the wind velocity.

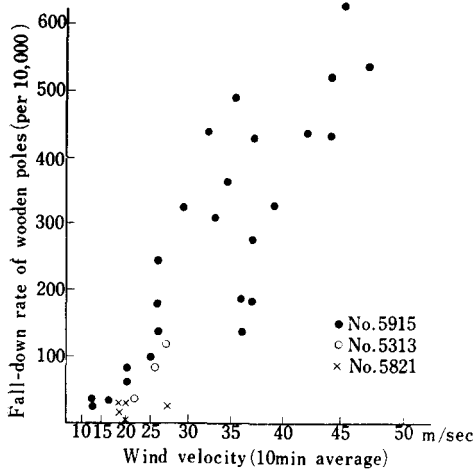


Fig. 3

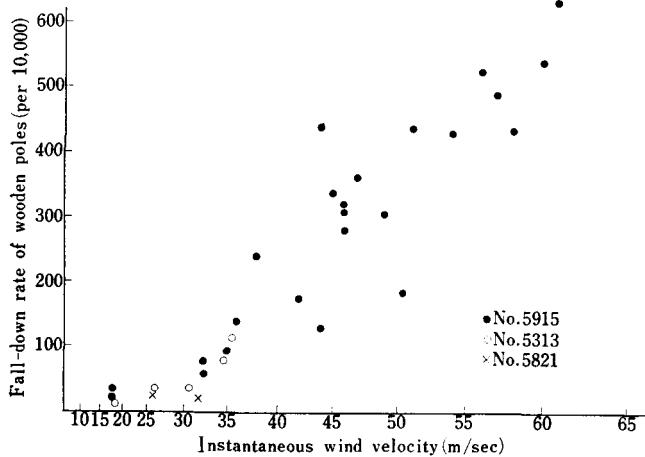


Fig. 4

actual experiences frequently because typhoons approach the Chubu

Furthermore, concerning the main materials such as electric lines, pole transformers and so on, we can predict the approximate damages by a similar analysis.

2. 2 Typhoon game

From the viewpoint of the prevention of damages, it is most important for the directors of each section to judge accurately the changing situations hour by hour and to take measures according to the requirements of the situation.

As the typhoon brings great damages during a short period, the emergency acts like military operations. We can obtain the ability to judge the varying situations exactly and carry out the emergency measures only from the actual experiences. But it is difficult to gain the

district only at rare intervals.

Then sham exercises are taken into consideration. In August, 1960, our company performed a sham training on the prevention of disaster on a large scale.

But we cannot practice often because of expenditure and materials needed. Furthermore it is difficult to estimate objectively whether the judgements of the directors were good or bad in the results.

On the contrary, it is expected by simple experiments on the desk that a sham exercise game is more effective than actual practice. This is because we can try bold methods which were not performed from caution, and reinvestigate the methods which was thought as the best up to this time.

Now we are planning the typhoon game that mainly applied to the business departments of our company. Fig 5 shows an example of the game for the branches.

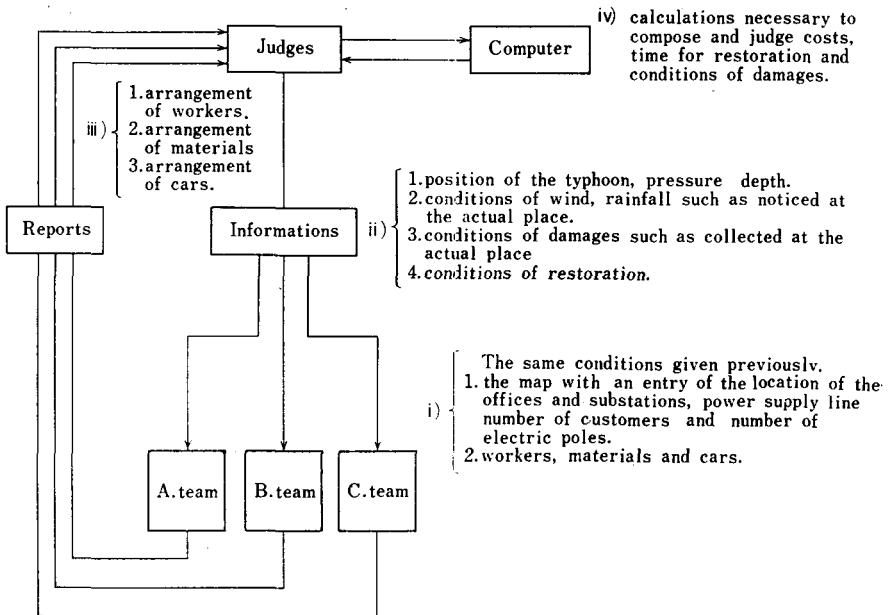


Fig. 5

i) The following items given to each team previously.

- The map within the jurisdiction of each branch with an entry of the location of each office, number of customers, route of the power supply, road, railway, etc.
- The list of goods in stock.
- Number of cars and workers.
Especially it is necessary to divide the workers according to their functions.
- ii) Information.
The following information are sent to each team timely.
 - The pressure depth in the center, radius, progressing speed, position of the center of the typhoon.
These information are sent in the same form as announced by the Meteorological Observatory at some time-intervals after the typhoon passes the latitude thirty degrees north.
 - The wind velocity and direction, rainfall.
These information are composed by calculation of the wind distribution according to the typhoon model and sent to each team.
 - The disaster conditions.
These information are composed by the method mentioned in 2. 1 and the fixed-time disaster information and great damages such as a substation stop considered separately.
 - The outlooks of other branches.
 - The general arrangements, materials etc.
When reinforcements to each branch are required, the judge (place in the head office) must arrange workers, materials, etc. according to the overall damages of the company and answer each branch.
 - The connection with other electric companies.
 - The conditions of the repair-works.
The judge must compose the repair-work informations based on the countermeasures reported from each team and send it to each team.
- iii) Report of the countermeasures.
Each team carries out the repair-work and the prevention work subject to the information of the typhoon, damages, etc.

and must report the contents of these countermeasures carried out to the judges. The contents of these countermeasures will be like the following.

- The countermeasures for the flood based on the consideration of past experiences.
- The arrangements of workers, materials and cars for the repair-work of the power supply lines.
- The planning of repair-construction.
- P. R. by service cars for controlling the complaints and the offering of the stoppage of the electric current.
- Consideration of the efficiency of repair-works in arrangement of workers.

We establish the form of the report of these main problems. By the report, we make up the information of the repair-conditions, such as the transmission rate of electric power by means of a graph such as Fig 6, and send them to each team.

Of course, the restoration speed is the function of workers, cars etc. and cannot be determined only by Fig 6.

iv) Calculation.

In order to compose the above-mentioned information on the typhoon, wind, rainfall and damages, the calculation by simulating the typhoon model is the most important.

Since the calculations are considerably complicated, we must utilize a large scale electronic computer to calculate the time variation of the wind velocity in the game.

But we do not have one at hand, so we previously calculate it.

There are many variations in the methods to calculate the damages,

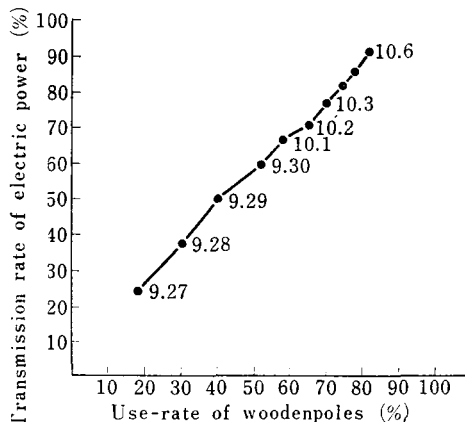


Fig. 6

repair-work and judgements, so we must be ready with calculating diagrams so that we might calculate them at the actual places.

v) Judgement.

At the final stage of the game judgements are performed.

Of course, it is naturally best to repair as early and fairly as possible and cheaply. But in case of small damages, a complete repair-work is better than a temporary work and in case of great damages it is necessary to send light again as early and widely as possible even if the repair-work is rough.

Also there is the problem of the preservation of public peace.

In the case of a very large size typhoon such as No. 5915, there is no limitation of cost for the repair-work.

In these cases, the criteria of judgement are more complicated. There are many difficult problems but the ideal method for the various cases will be developed through the game.

2.3 Economical strength of electric facilities for wind

The design strength of electric facilities for wind has been determined for the yearly maximum wind velocity 40m/sec all over Japan, but the maximum wind velocity differs from place to place.

Therefore the economical design strength ought to differ from place to place. In order to analyze this problem, we must combine the model of the destruction power due to wind, the model of the trend to weaken the strength of the facilities, and economical considerations.

i) Model of the destruction power.

The distribution of the yearly maximum wind velocity is available for this problem. But since there are much difficulties in this method, we are further considering to simulate the typhoon model as to make up for the distribution of the yearly maximum wind velocity.

Concerning the typhoon path, K. Takahashi⁽¹⁾ pointed out that there were noticed three periods of 4, 6.58 and 60 years in the number of typhoons approached, and R. Saito pointed out that there was noticed the period of 5 years in the number of typhoons that landed Japan in a year following the Poisson distribution.

It is very difficult to consider which course a typhoon will pass. But we assume the course of a typhoon will probably pass near one of the typical courses of past typhoons.

ii) Model of the trend to weaken the strength of facilities.

The strength of electric facilities become weaker year by year, but it is much complicated to analyze this problem because the facilities have different characteristics. For example a wooden pole has no corrosion at first, but once it receives corrosive action, it becomes weak rapidly.

We must consider this model statistically in the group of several thousand wooden poles or more.

iii) Economical consideration.

The stronger the facilities are designed, the more the investment is required. The damages of destruction are usually greater than the costs for pre-renewal.

Furthermore the damages are different from place to place in our electric company.

By combining the above-mentioned two models as shown in Fig. 7 and taking economy into consideration, we can determine the most economical initial strength and when or at which strength we must renew the facilities.

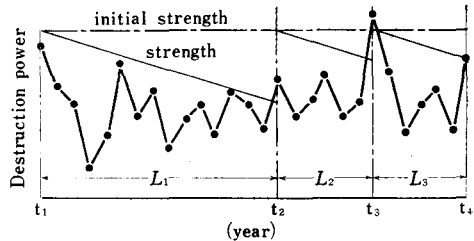


Fig. 7

Our purpose is to solve the problems mentioned in 2. 1 and 2. 3, and the point of the problems is how the destruction power comes out.

The problems of damage prediction, typhoon game, and economical design are solved accordingly to the destruction power. Then how we simulate the destruction power of the typhoons becomes the important problem.

Concerning the problems of damage prediction and typhoon game, we need to know how the destruction power at each place changes hour by hour.

In the problem of the economical design of the electric facilities, it is convenient to deal with the destruction powers statistically as appeared every year, and beyond this we use the typhoon model to make up for the lack of data.

3. TYPHOON MODEL (1)

In this chapter we shall explain the typhoon model considered from the wind distribution in the region of the typhoon.

3.1 Wind distribution in the region of the typhoon

The wind distribution within the typhoon is considerably irregular because of the complicated topographical features. Therefore, in the analysis we considered two separate model, namely, that which ignored the topographical features and that which included the topographical influences.

We attempted to form the empirical formula combining the appropriate topographical factors to the ratio V/V_0 , where V is the theoretical wind velocity resulting from the ideal model and V_0 the observed wind velocity.

There are many ways to represent the wind model of the typhoon, but we represented the wind model as the vector summation of the gradient wind and the field wind that drifts the typhoon.

a) Gradient wind (V_θ)

If we may assume the circular form of the isobar lines and ignore the effects of wind friction, the wind velocity in an ideal cyclone at a stationary state is given by the following equation.

$$V_\theta = -r\omega \sin \varphi + \sqrt{r^2\omega^2 \sin^2 \varphi + \frac{r}{\rho} \frac{\partial \rho}{\partial r}},$$

where r is distance from center of typhoon,

ρ air density,

ω angular velocity of the earth,

φ latitude,

$\partial \rho / \partial r$ pressure gradient.

b) Field wind (V_b).

Assuming that the field wind velocity is proportional to the progressing velocity of the typhoon, decreasing as the distance from the center of the typhoon increases and that the ratio of the field wind velocity to the progressing velocity of the typhoon becomes $e^{-\pi}$ at the point of 1,000 mb, we get

$$V_b = V_0 e^{-\pi r},$$

where V_0 is progressing velocity of typhoon,

λ parameter,

r distance from center of typhoon,

c) Theoretical wind velocity (V).

The theoretical wind velocity V was calculated from the vector summation of V_θ and V_b .

d) Topographical factors.

Comparing the calculated wind velocity with the observed one, it is seen that the calculated value is 50% greater than the observed value and the calculated wind direction deviates about 30 degrees inside from the observed wind direction. (see table 2).

It is possible for us to consider that the ratio V/V_0 depends mainly on the topographical features. Therefore this ratio may be represented by a function of the appropriate topographical factors.

The topographical factors mainly consist of elevation, rise, exposure, orientation, etc.

3. 2 Pressure distribution within the typhoon.

In order to calculate the gradient wind and the field wind, we have to know the pressure distribution within the typhoon.

As we see on the weather maps, the isobar lines in the inner region of the typhoon is approximately circular, but it is not exact. We don't have enough observatory stations to know the three-dimensional profile which is necessary to obtain good results. Even if we have such observed values, it is difficult to use them because of technical difficulties and the time of computation.

T. Fujita⁽²⁾ gave the following equation representing the mean pressure along the circle with radius R km from the center.

$$\bar{P}_R = \frac{1}{2\pi} \int_0^{2\pi} P_{R\theta} d\theta, \quad (1)$$

The observed pressure distributions within the typhoons are shown in Fig. 8.

As we can see in Fig. 8, the curve of the pressure distribution is flat in the center, parabolic for the inner region, and hyperbolic for the outer region and converges to a constant value.

Introducing a variable x , the dimensionless quantity defined as the ratio r/r_0 , K. Takahashi⁽¹⁾ presented the following equation.

$$P = P_{\infty} - \frac{\Delta P}{1+x},$$

and V. Bjerknes presented

$$P = P_{\infty} - \frac{\Delta P}{1+x^2},$$

where P is the pressure r km from the center, P_{∞} the pressure undisturbed by the typhoon, ΔP the depth of the pressure funnel and r_0 the constant for each typhoon.

It has been proved that the former equation is capable of representing the pressure curves in the outer areas and the latter capable of representing the inner areas of the typhoons well.

Taking the above-mentioned characteristics of the two equations into consideration, T. Fujita⁽²⁾ obtained an equation which coincides with the equation by Takahashi in the outer area, and with that by V. Bjerknes in the vicinity of the center, that is,

$$P = P_{\infty} - \frac{\Delta P}{\sqrt{1+x^2}}, \quad (2)$$

and this equation was developed further, that is,

$$P = P_{\infty} - \frac{\Delta P}{\sqrt{1 + \left(x \frac{x+1}{x+a}\right)^2}} \quad (3)$$

Table 1

No. date	r_6	$\frac{r_0}{r_6/6}$	P_6	P_0	$\frac{P'}{P_6 - P_0}$	$\frac{\Delta P(P' \times 1.167)}{P_6 - P_0}$	$\frac{P_{\infty}(P_0 + \Delta P)}{P_6 - P_0}$	Equation
15. 26. 18	600	100	1005	929	70	91.0	1000.0	$P = 1020.0 - \frac{91.0}{\sqrt{1 + \left(\frac{r}{100}\right)^2}}$
19	540	90	998	948	50	59.8	1007.8	$P = 1007.8 - \frac{59.8}{\sqrt{1 + \left(\frac{r}{90}\right)^2}}$
20	540	90	1000	950	50	59.8	1008.8	$P = 1009.8 - \frac{59.8}{\sqrt{1 + \left(\frac{r}{90}\right)^2}}$
21	540	90	1000	950	50	59.8	1009.8	$P = 1009.8 - \frac{59.8}{\sqrt{1 + \left(\frac{r}{90}\right)^2}}$

where, a is the cyclone-constant for each typhoon.

Equation (3) can represent the pressure profiles better than equation (2), but it is complicated to use equation (3) for computation. Therefore we adopted equation (2) and we determined the constants P_∞ , ΔP and r_0 by applying the empirical equation (2) to the curve obtained by directly plotted the observed pressures at each station.

While the typhoon is progressing on the sea, we cannot use this method, but at present it is unnecessary for us to know the pressure profile on the sea because our purpose is to discuss the topographical factors disturbing the wind distribution in the typhoon areas.

Considering that r_0 is in the range of about 100 km to 300 km, ΔP about 40 mb to 100 mb, and the pressure increase is only 1 mb/100 km at $r=6r_0$, we calculated ΔP and P_∞ by the pressure depth P_0 and the unit radius r_0 obtained by taking $6r_0$ for the distance that the pressure curve obtained by plotting the observed values at each station was convergent to the constant. Then we can find out the constants r_0 , ΔP and P_∞ .

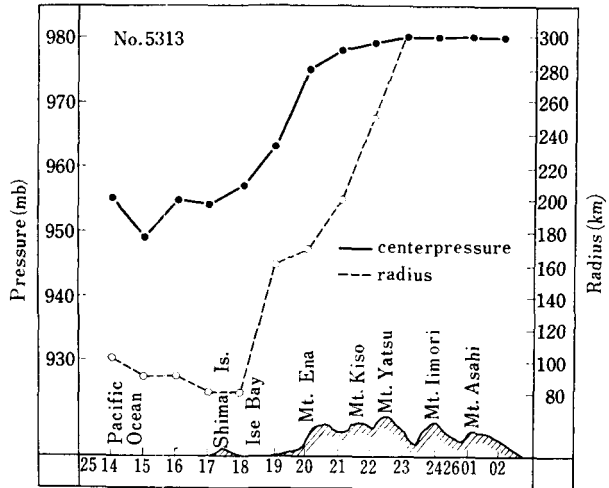


Fig. 8

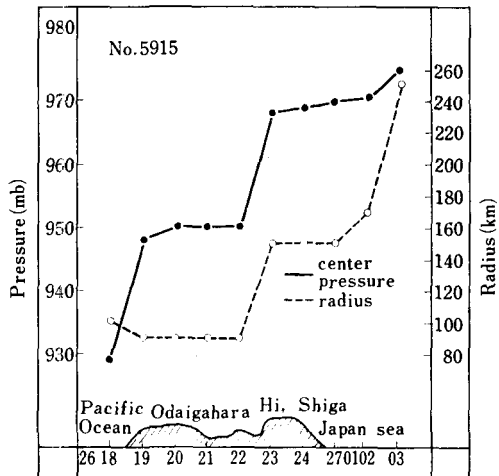


Fig. 9

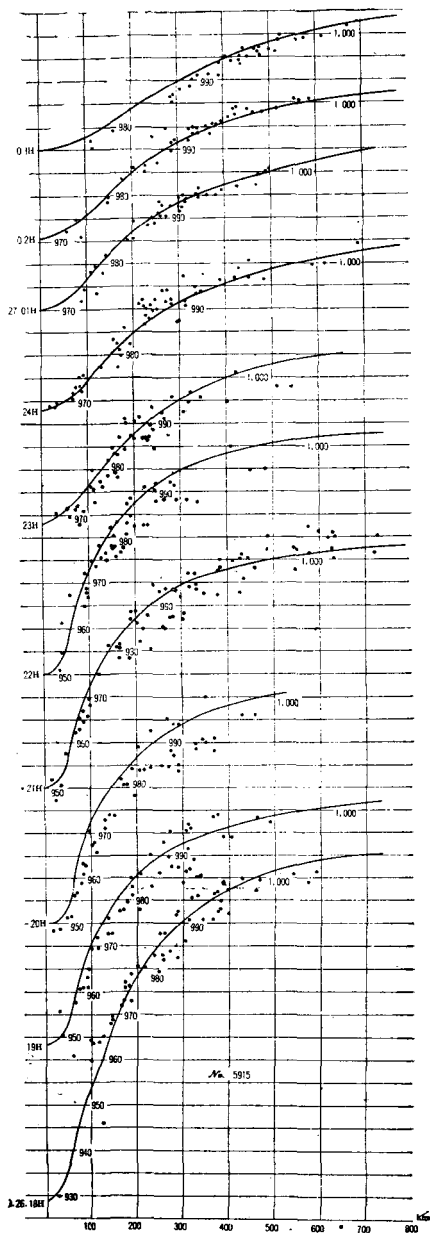
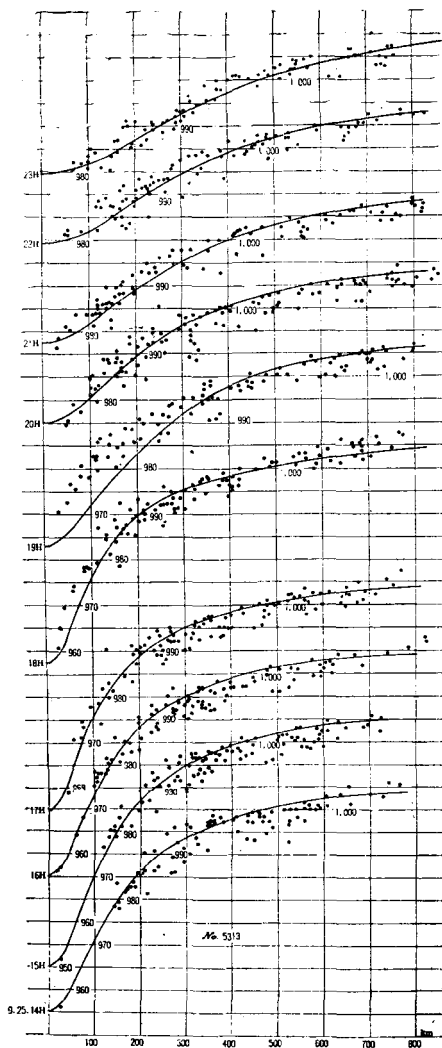


Fig. 10—11

following the computation procedure shown in Table 1.

3, 3 V/V_0 .

In this paragraph we summarize the computation procedures.

i) Pressure profile is

$$P = P_{\infty} - \frac{\Delta P}{\sqrt{1 + \left(\frac{r}{r_0}\right)^2}}$$

In this equation we find out the constants P_{∞} , ΔP and r_0 by the method described in paragraph 3.2.

ii) Field wind is

$$V_b = V_0 e^{-\lambda r}$$

where V_0 is the speed of the typhoon movement and λ is

$$\lambda = \frac{\pi}{r_0 \left\{ \sqrt{\left(\frac{\Delta P}{P_{\infty} - 1000} \right)^2} - 1 \right\}}$$

iii) Gradient wind is

$$V_{\theta} = -r\omega \sin \varphi + \sqrt{r^2 \omega^2 \sin^2 \varphi + \frac{r}{\rho} \cdot \frac{\partial \rho}{\partial r}},$$

where $\omega = 7.29 \times 10^{-5}$ radian/sec,

$\rho = 1.293 \times 10^{-3}$ g/cm³,

φ = latitude,

r and $\partial \rho / \partial r$ are calculated every time and at each observation station.

iv) Theoretical wind is

$$V = \sqrt{V_b^2 \sin^2 \left(r + \frac{\pi}{2} \right) + \left\{ V_{\theta} - V_b \cos \left(r + \frac{\pi}{2} \right) \right\}^2},$$

and

$$\delta = \tan^{-1} \frac{V_b \sin \left(r + \frac{\pi}{2} \right)}{V_{\theta} - V_b \cos \left(r + \frac{\pi}{2} \right)} + r + \frac{\pi}{2} + \alpha,$$

Where

$$-\frac{\pi}{2} \leq \tan^{-1} \left\{ \frac{V_b \sin \left(r + \frac{\pi}{2} \right)}{V_{\theta} - V_b \cos \left(r + \frac{\pi}{2} \right)} \right\} \leq \frac{\pi}{2},$$

V is the theoretical wind velocity,
 α is the theoretical wind direction.

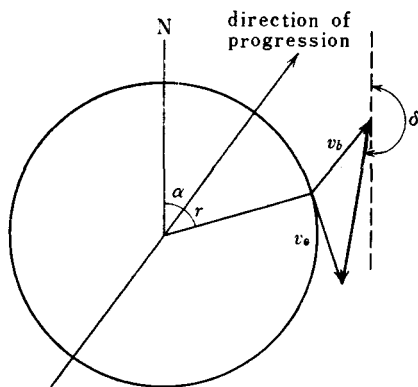
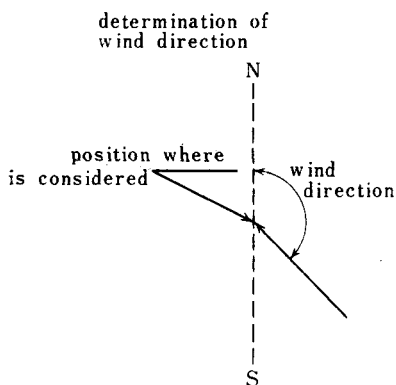


Fig. 12

v) V/V_0

We can obtain the ratio V/V_0 by dividing the theoretical wind velocity calculated in iv) by the observed wind velocity. The results are shown in Table 2.

ACKNOWLEDGEMENT

In conclusion of this report, we express our hearty thanks for the kind advices to Dr. K. Takahashi, Dr. R. Saito, Dr. M. Miyazaki of the Meteorological Agency, Mr. E. Suzuki, investigator at the Meteorological Institute, Mr. K. Ohtani the director of the Observation Section of the Nagoya Meteorological Observatory, Mr S. Shimura, researcher of our company.

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2. T. Fujita, Study in Typhoon, Chapter 1 Pressure Distribution Within Typhoon,

Table 2

Nagoya

Location code	No. of typhoon	Date	Position of center	Speed of typhoon	Calculated wind	Observed wind	Calculated wind/ Observed wind
			lat. lon.	vel. dir.	vel. dir.	vel. dir.	
636	5313	9. 25. 14	33. 2 35. 8	1. 0 30	7. 8 090	26. 6 440	3. 4
636	5313	9. 25. 15	33. 5 36. 1	1. 1 40	8. 7 090	29. 2 102	3. 4
636	5313	9. 25. 16	33. 3 36. 2	1. 1 15	10. 7 090	31. 6 439	3. 0
636	5313	9. 25. 17	34. 2 36. 6	1. 1 40	10. 5 090	32. 3 451	3. 1
636	5313	9. 25. 18	34. 6 36. 8	1. 1 22	13. 2 067	27. 5 448	2. 1
636	5313	9. 25. 19	34. 9 37. 0	1. 1 30	13. 0 022	3. 1 452	0. 2
636	5313	9. 25. 20	35. 3 37. 4	1. 9 39	19. 0 337	19. 3 255	1. 0
636	5313	9. 25. 21	35. 8 37. 9	1. 9 39	12. 7 295	25. 2 265	2. 0
636	5313	9. 25. 22	35. 4 38. 5	2. 5 38	5. 4 270	26. 0 279	4. 8
636	5313	9. 25. 23	37. 3 39. 0	2. 8 24	10. 3 270	24. 8 266	2. 4
636	5313	9. 25. 24	37. 9 39. 5	2. 2 33	11. 5 270	23. 2 271	2. 0
636	5313	9. 26. 01	38. 4 39. 9	1. 5 33	9. 1 270	21. 4 262	2. 4
636	5313	9. 26. 02	38. 7 40. 3	1. 5 35	8. 7 270	20. 0 268	3. 3
636	5313	9. 26. 03	39. 2 40. 8	1. 7 39	7. 3 270	18. 0 263	2. 5
636	5313	0. 26. 04	39. 6 41. 3	1. 7 44	6. 1 270	15. 6 263	2. 6
636	5313	9. 26. 05	39. 9 41. 7	1. 7 45	8. 5 295	15. 0 265	1. 8
636	5313	9. 26. 06	40. 3 42. 2	1. 9 44	7. 1 295	13. 5 265	1. 9
636	5915	9. 26. 18	33. 4 35. 5	1. 9 00	16. 1 115	39. 6 106	2. 5
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636	5915	9. 26. 22	35. 6 36. 5	2. 3 20	37. 0 160	48. 7 196	1. 3
636	5915	9. 26. 23	36. 1 36. 9	1. 9 34	21. 0 180	35. 5 230	1. 7
636	5915	9. 26. 24	36. 7 37. 4	2. 3 33	18. 2 205	35. 3 240	1. 9
636	5915	9. 27. 01	37. 3 37. 9	2. 2 35	16. 6 205	29. 8 251	1. 8
636	5915	9. 27. 02	38. 0 38. 4	2. 6 31	6. 9 180	24. 7 258	3. 6
636	5915	9. 27. 03	38. 9 39. 0	3. 1 27	4. 6 160	21. 9 263	4. 7
651	5313	9. 25. 14	33. 2 35. 8	1. 0 30	20. 8 090	30. 6 436	1. 5
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651	5313	9. 25. 19	34. 9 37. 0	1. 1 30	18. 7 315	17. 3 273	1. 0
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651	5313	9. 25. 21	35. 8 37. 9	1. 9 39	12. 7 270	29. 5 270	2. 2
651	5313	9. 25. 22	36. 4 38. 5	2. 5 38	14. 9 270	25. 9 282	1. 7
651	5313	9. 25. 24	37. 9 39. 5	2. 2 33	6. 1 295	21. 6 273	3. 5
651	5313	9. 26. 01	38. 4 39. 9	1. 5 33	3. 4 270	19. 6 262	5. 8
651	5313	9. 26. 02	38. 7 40. 3	1. 5 45	5. 5 270	18. 2 270	3. 3
651	5313	9. 26. 03	39. 2 40. 8	1. 7 39	5. 7 270	16. 3 264	2. 9
651	5313	9. 26. 04	39. 6 41. 3	1. 7 44	4. 4 295	14. 7 263	3. 3
651	5313	9. 26. 06	39. 9 41. 7	1. 7 45	5. 5 295	13. 6 265	2. 5

Location code	No. of typhoon	Date	Position of center	Speed of typhoon	Calculated wind	Observed wind	Calculated wind/ Observed wind
			lat. lon.	vel. dir.	vel. dir.	vel. dir.	
651	5313	9. 26. 06	30. 3 42. 2	1. 9 44	3. 2 270	12. 3 266	3. 8
651	5915	9. 26. 18	33. 4 35. 5	1. 9 00	26. 4 115	45. 5 105	1. 7
651	5915	9. 26. 19	34. 0 35. 8	2. 0 24	33. 6 115	36. 7 121	1. 1
651	5915	9. 26. 20	34. 3 36. 0	1. 1 28	35. 0 135	34. 0 132	1. 0
651	5915	9. 26. 21	34. 9 36. 2	1. 9 16	24. 3 180	37. 5 201	1. 5
651	5915	9. 26. 21	34. 9 36. 2	1. 9 16	18. 0 135	36. 8 162	2. 0
651	5915	9. 26. 22	35. 6 36. 5	2. 3 20	12. 9 225	48. 3 226	3. 7
651	5915	9. 26. 23	36. 1 36. 9	1. 9 34	13. 0 225	35. 2 249	2. 7
651	5915	9. 26. 24	36. 7 37. 4	2. 3 33	7. 8 247	31. 2 249	4. 0
651	5915	9. 27. 03	38. 9 39. 0	3. 1 27	7. 8 247	19. 3 266	2. 5
656	5313	9. 25. 14	33. 2 35. 8	1. 0 30	10. 1 115	22. 9 103	2. 3
656	5313	9. 25. 15	33. 5 36. 1	1. 1 40	12. 9 115	25. 3 130	2. 0
656	5313	9. 25. 16	33. 8 26. 2	1. 1 15	13. 7 135	27. 5 110	2. 0
656	5313	9. 25. 17	34. 2 36. 6	1. 1 40	16. 5 135	30. 4 136	1. 8
656	5313	9. 25. 18	34. 6 36. 8	1. 1 22	17. 6 160	34. 3 143	1. 9
656	5313	9. 25. 19	34. 9 37. 0	1. 1 30	14. 0 160	32. 5 143	2. 3
656	5313	9. 25. 20	35. 3 37. 4	1. 9 39	19. 9 180	27. 9 176	1. 4
656	5313	9. 25. 21	35. 8 37. 9	1. 9 39	18. 0 205	27. 7 209	1. 5
656	5313	9. 25. 22	36. 4 38. 5	2. 5 38	16. 3 205	28. 8 241	1. 8
656	5313	9. 25. 23	37. 3 39. 0	2. 8 24	12. 2 225	26. 9 241	2. 2
656	5313	9. 25. 24	37. 9 39. 5	2. 2 33	15. 0 225	24. 9 251	1. 7
656	5313	9. 26. 01	38. 4 39. 9	1. 5 33	6. 1 205	22. 8 245	3. 7
656	5313	9. 26. 02	38. 7 40. 3	1. 5 45	6. 3 247	21. 4 253	3. 4
656	5313	9. 26. 03	39. 2 40. 8	1. 7 39	8. 0 270	19. 5 251	2. 4
659	5313	9. 26. 04	39. 6 41. 3	1. 7 44	4. 8 270	17. 7 251	3. 7
656	5313	9. 26. 05	39. 9 41. 7	1. 7 45	6. 3 247	16. 5 255	2. 6
656	5313	7. 26. 06	40. 3 42. 2	1. 9 44	5. 2 247	14. 8 256	2. 8
656	5313	9. 26. 18	33. 4 35. 5	1. 9 00	12. 0 115	33. 1 124	2. 8
656	5313	5. 26. 19	34. 0 35. 8	2. 0 24	16. 5 135	28. 8 138	1. 7
656	5915	9. 26. 20	44. 3 36. 0	1. 1 28	16. 8 135	30. 6 149	1. 8
656	5915	9. 26. 22	35. 6 36. 5	2. 3 20	19. 9 180	39. 9 173	2. 0
656	5915	9. 26. 23	36. 1 36. 9	1. 9 34	21. 4 205	35. 0 193	1. 6
656	5915	9. 26. 24	36. 7 37. 4	2. 3 33	19. 3 205	34. 3 211	1. 8
656	5915	9. 27. 01	37. 3 37. 9	2. 2 35	13. 7 225	30. 2 227	2. 2
656	5915	9. 27. 02	38. 0 38. 4	2. 6 31	12. 5 225	26. 0 238	2. 1
656	5915	9. 27. 03	38. 9 39. 0	3. 1 27	11. 5 225	22. 9 247	2. 0