# The Recent Status of Secular Variations of the Atmospheric Electric Elements and their Relation to the Nuclear Explosions.

By

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## 概　　要

柿岡に於ける気象電気要素の最近の変化には次のような異状がみられる.

1. 電位傾度の減少
2. 電気伝導度の増加
3. 空地電流の増加
4. 空間電荷には異常が認められない

このような変化は人工放射能の最近の増加と関係があると思われる.

## § 1, Introduction

The recent status of secular variations of the atmospheric celectri elements for calm days at Kakioka seems to be abnormal. In this paper, the author first reports the observational details of this abnormality and then discusses its probable causes from various atmospheric electric and meteorological standpoints. Finally, he finds an intimate connection between the abnormal changes of the atmospheric electric elements and artificial radioactivity due to the test explosions of the nuclear bombs, referring the results at some other stations in the world.

## § 2. Statistical Results

The secular variations of the potential gradient, electric conductivity, air-earth current which can be expressed by the product of the potential gradient and electric conductivity, and the space charge are computed from the observational data at the Kakioka Magnetic Observatory for the period, 1930-1957. The results are shown in Fig. 1. In this figure one can find clearly that the following characteristics of the variation curves since 1952 or 1953 are predominant and substantially different from the changes before about 1950,

1. Potential gradient is decreasing,
2. Electric conductivity is increasing,
3. Air-earth current is increasing,

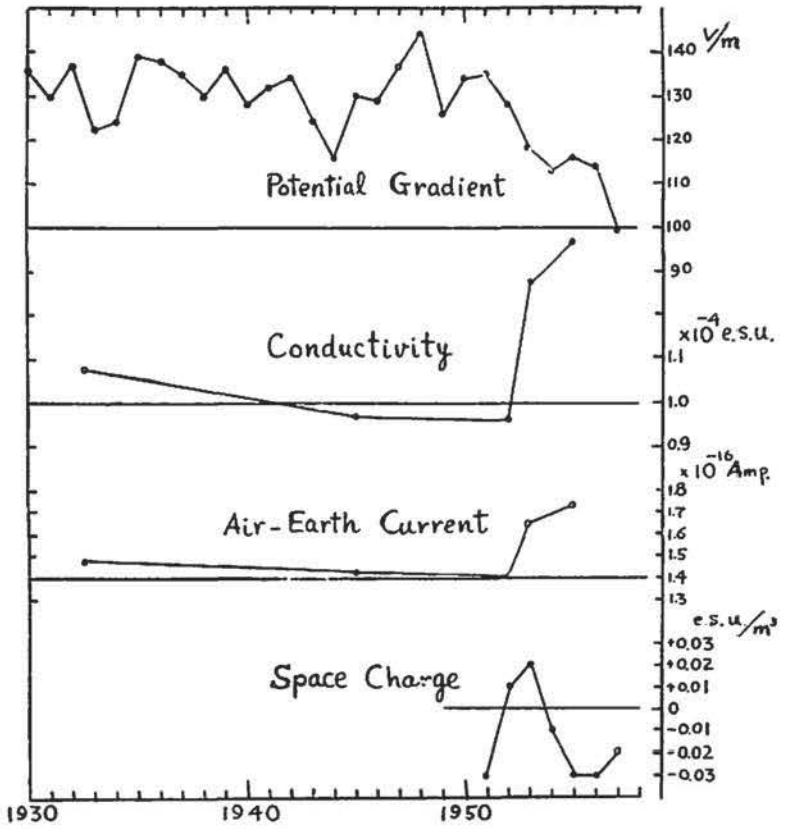


Fig. 1. The secular variations of the atmospheric electric elements observed at Kakioka.

4. Space charge has no trend.

## § 3. Discussions

As the probable causes of such secular variations, we may be able to consider the followings;

1. Growth of towns near the Observatory
2. Wide change of meteorological conditions
3. Change of ion-production.

In the following will be discussed briefly the above mentioned factors.

1. Growth of town near the observatory

If the town near the observatory grows appreciably, as Chalmars or Nakano reported [1], [2], the exhausted gases from houses and factories will disturb the atmospheric electric conditions, which may alter the modes of the diurnal variations of the electric elements, and especially for the space charge, affect even the absolute magnitude.

But, the growth of town since 1952 is not conspicuous, near the Kaki-

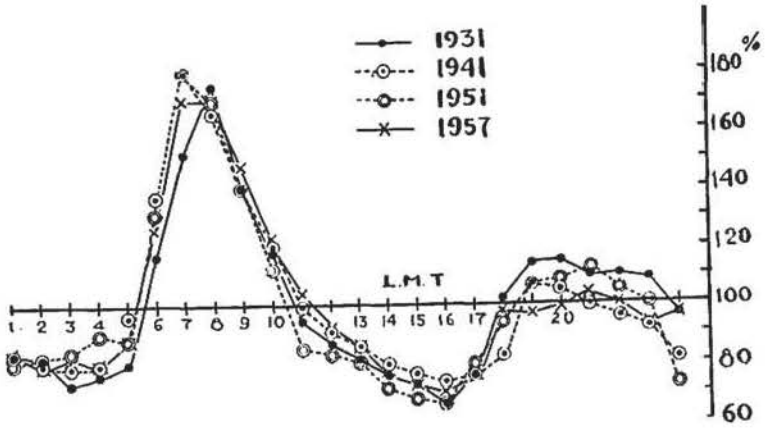


Fig. 2. The diurnal variation of Potential gradient.

oka Magnetic Observatory. Furthermore, the diurnal variation of the potential gradient, as shown in Fig. 2, makes no appreciable changes during the period from 1931 to 1957, and as afore-said, the secular variation of the space charge has no trend.

It is difficult, therefore, to attribute the abnormal secular variations to the growth of town near the Observatory.

2. Wide change of meteorological conditions

Some authors say that there are some relationships between the potential gradient and solar activity, [3]. The solar activity may stimulate the meteorological condition and the affected changes of the latter may give rise to the corresponding changes of the potential gradient. But such a relation between the atmospheric electric conditions and the meteorological conditions does not seem to be able to explain the large abnormal changes observed, though the above mentioned paper does not state the relation since 1954.

3. Change of ion-production

Unfortunately, we have no observations of the ion-production and therefore, we can not answer "How abcrmal is the ion-production during the period, which is controlled by the radio active contaminations in the air or on the ground?". However, it is obvious that the artificial radioactivity is recently increasing due to the test explosions of the nuclear bombs, and if we suppose that the ion-productions in the lower atmosphere or on the ground are increased by such radio activity, the abnormality mentioned in § 1 may be able to be understood qualitatively, [4]. In Fig. 3 are shown, the accumulated values of Sr 90 in Japan from March, 1955 and the accelerated values of the potential gradient, excepted

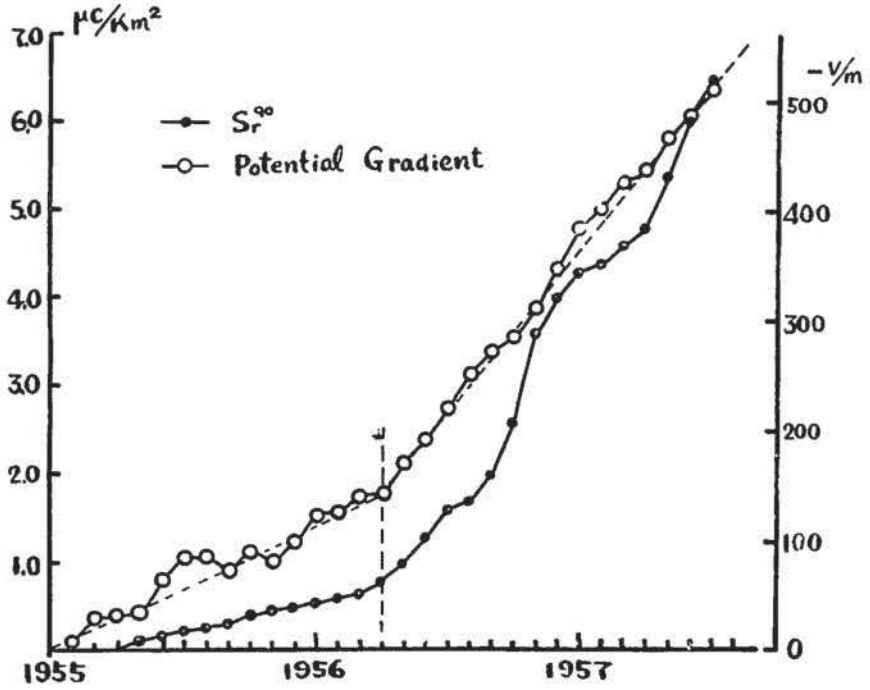


Fig. 3. The accumulated values Sr 90 of and accelerated value of Potential gradient.

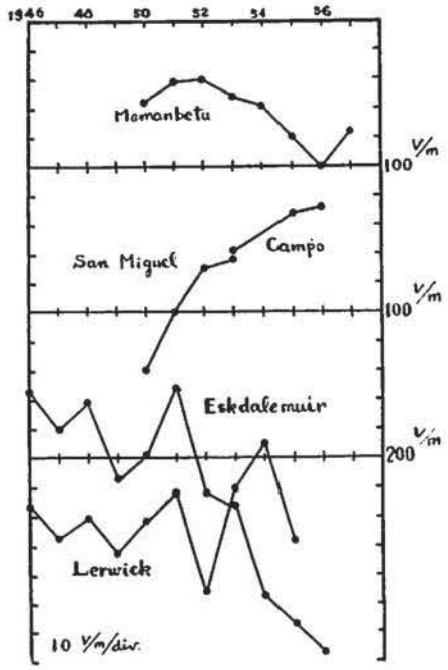


Fig. 4. The secular variations of Potential gradient at Memambetsu, Sun Miguel, Campo, Eskdalemuir and Lerwick.

the mean values from 1930 to 1940, for which period the values are not effected by the artificial radioactivity. The accumlation of Sr 90 is taken only for the measure of the artificial radioactivity. Comparing the two curves, it is found that there is a clear relationship between Sr 90 and potential gradient. Namely, the value of Sr 90 increases suddenly in March, 1956 and at the same time, the mean value of potential gradient decreases about 20 v/m.

In Fig. 4, the secular variations of the potential gradient at Memambetsu, Campo, San Miguel, and Lerwick are shown, and in Fig. 5, the distribution of the accumulated value of Sr 90 from 1951 to 1955 over the world. Referring the two figures, it may be said that in both England and Japan the value of Sr 90 is great and the potential gradient is decreasing, but, in Spain and Aruzentin, the value is small and the potential gradient rather increasing. These facts suggest an inti-

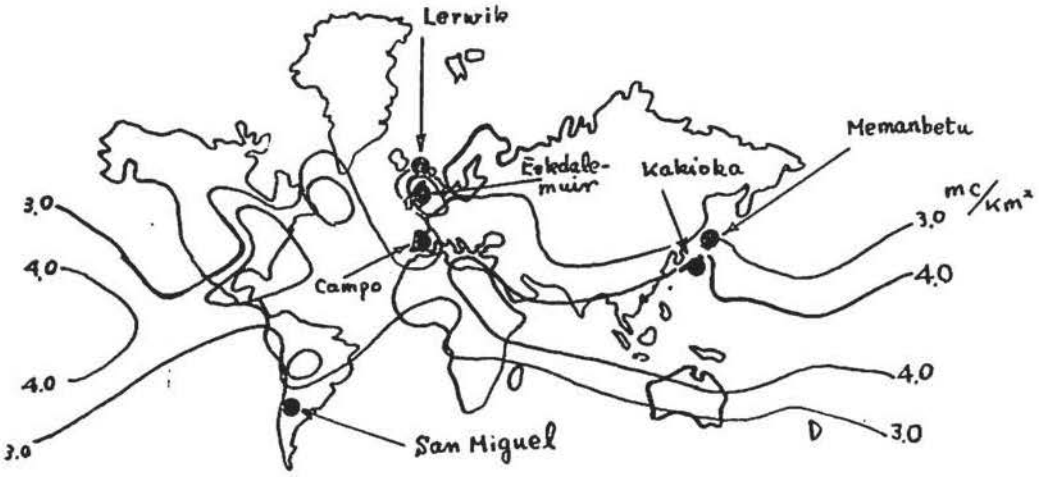


Fig. 5. The distribution of accumulated value of Sr 90 from 1951 to 1955.

mate between the artificial radioactivity and the variations of the atmospheric electric elements.

In order to discuss the problems more quantitatively, we must know the changes of observed values of the following factors and those are retained in future.

1. The column resistance from the earth's surface to the ionosphere
2. The secular variations at many stations over the world
3. The rate of ion-production by artificial radioactivity

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