Spinel type crystal is generally expressed by a formula of $AX \cdot B_2X$, or AB_2X_4, where A and B are divalent and trivalent metal respectively and X is divalent negative ion such as oxygen or sulpher.

Experiments on resistivity show that the next formula is valid in these cases.

$$\rho = Ae^{\frac{B}{T}}$$

But log ρ versus $1/T$ curves have mostly a kink at about 200°C. The values of B are 1000–8000°K, and generally large B corresponds to large ρ. For practical use, use, large B and small ρ is desirable. Co_4Mn_2, Mn_4Ni_2 and Mn_4Cu_2, Mn_4Ni_2 fulfil the above condition in some extent.

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6. Study of Semi-conductors. (V)

Dielectric Properties of Spinel Type Semi-conductor

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During the measurement about resistivity of spinel type semi-conductor, it was found that some of the specimens apparently had remarkably large dielectric constant at low frequencies. And accordingly experimental studies on dielectric properties of such materials were carried out. Measurements were carried about all specimens previously prepared for resistivity measurements, and anomalous large dielectric constant more than 10^4 was found among the specimens consisted of Fe–Co, Fe–Ni and Fe–Zn.

Specimens were again prepared for dielectric measurement, the method of which was similar to that of the preparation of specimen for the resistivity measurements. A parallel resistance bridge was employed for the dielectric measurements, and frequency and temperature characteristics of ε and tan δ were determined.

Generally high ε specimen has low resistivity, and high resistance specimen has low ε, but not all low resistance specimens have large ε. The dielectric constant generally becomes large according to the frequency decrease, and log ε nearly satisfies a linear relation with log f, at the frequency range of 10^2 and 10^4. If a linear relation exist

$$\varepsilon \cdot f^x = \text{constant}$$

where x is generally smaller than 1, but in some specimens such as Fe_9Zn_3, $Fe_{10}Zn_2$, Fe_6Co_6 and Fe_7Co_5, is nearly equal to 1.

The value of tan δ is commonly very large in these materials. The frequecy characteristics of tan δ have various curves of different kinds according to $\varepsilon \sim f$

characteristics.

The values of ε and tan δ are also very much sensitive to the temperature. The temperature characteristics shows that both ε and tan δ become larger with the rise of temperature.

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7. The Quantitative Determination of Arsenic in Sea-Water

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The authors have quantitatively determined arsenic in sea-water by Gutzeit method by the following procedure ; 1~2 L of sea-water was taken, added 20 mg of Fe^{+++} as $FeCl_3$ solution, then neutralized with NH_4OH and allowed to stand for 2~3 days. Arsenic in the sample was absorbed by $Fe(OH)_3$ and its coprecipitation is nearly complete. The precipitate was filtered and dissolved in 30 ml of H_2SO_4 (1 : 9). This solution was transfered to As determination apparatus, and then arsenic was quantified by Gutzeit method. The results are shown in the following table.

Sea-water		As content γ/L (mean value)
32.5°N, 135°E	Cl=19.10‰ (Aug. 20 th. 1949)	3.3
33°42′40″N, 135°20′E	Cl=19.25‰ (Feb. 21 th. 1950)	6.0
35°44′46″N, 135°30′E	Cl=19.12‰ (Apr. 27 th. 1950)	4.0
33°42′38″N, 135°19′54″E	Cl=18.77‰ (Oct. 17 th. 1950)	3.0

From the above results, As content is found to be 3~6 γ/L, and the mean value 4γ/L.

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8. The Quantitative Determination of Vanadium in Sea-Water

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(Ishibashi Laboratory)

Vanadium in sea-water has been studied by Ernst and Hörman (Nathr, Ges. Wiss. Göttingen. (1936) (ii) 1). They determined V spectroscopically with the material concentrated with $Fe(OH)_3$ as carrior, and found 0.3 γ of V per L sea-water.

The authors quantified V in sea-water colorimetrically by phosphotungstate me-