ferential, the time lag for each compound being referred to carbon bisulfide or to some other standard liquid kept in cell B_1. From an empirical examination of a variety of substances Allison and Murphy concluded that "each chemical compound, regardless of the presence of other substances, produces its characteristic minimum (or minima) of light intensity," which persists at extremely low concentrations. They also stated that the positions of these minima are "functions of the atomic weights of the metallic elements of the compounds or, more precisely, of the atomic weights divided by the valence, that is, the chemical equivalents." The curves in Fig. 2 were

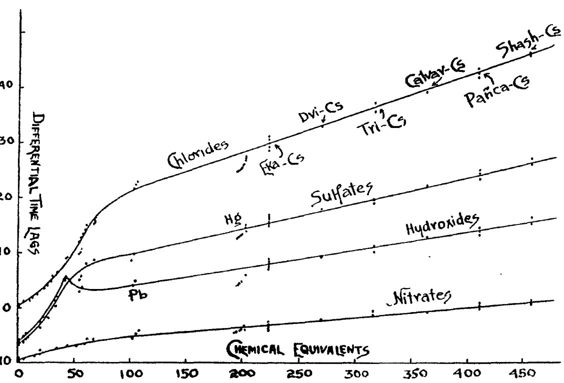

FIG. 2. Chemical equivalents of elements plotted against time lags. To avoid crowding few elements are recorded on this chart, and still fewer are designated with symbols.

obtained by plotting differential time lags against the chemical equivalents of a large number of elements in the form of chlorides, sulfates, hydroxides and nitrates. Such curves are claimed by Allison[3] to be "representative of the results for chemical equivalents up to 100 or thereabouts," and beyond this limit "they fail to conform to data." This claim, however, is obviously wrong, because in the very next paragraph Allison states that it was "entirely by this method that evidence of the presence of element 87 and later of element 85 was obtained." Both elements, 87 and 85, presumably are univalent, and the equivalent of each is considerably higher than 100. It was therefore deemed logical to utilize the magneto-optic method in search of elements with atomic weights higher than that of uranium.

With this object in view, the heavier analogues of ekacesium were decided upon. The decision was prompted by the assumptions that these elements, if existent, are apt to occur with cesium and rubidium in certain minerals and that they are univalent. Because of univalence their chemical equivalents will equal their respective atomic weights. But what are their atomic weights? This question of course is quite puzzling. By resorting to calculations based on the average difference of the atomic weights of the rarer alkalies, and by assuming the probability of long and short periodic series, the following values were decided upon: Dvicesium 271 and tricesium 315.

[3] Allison, *Ind. and Eng. Chem.*, Anal. Edition, 4: 10, 1932.

The experimental work was comparatively simple. Extracts of lepidolite were obtained, and the chloride, sulfate, hydroxide and nitrate were each placed in cell B_2 (Fig. 1) and readings were obtained with the Allison apparatus. As seen from the curves (Fig. 2) dvicesium has no isotopes, while tricesium has two.

But why stop with tricesium? The trolley wires were of ample length, and by assuming atomic weights for three additional alkalies, the following elements were observed: Catvarcesium 365, with no isotopes, pañcacesium, 412, and shashcesium, 459, with three and two isotopes, respectively. Shashcesium was the last alkali element to be observed by the magneto-optic method of analysis, because the end of the trolley wires had been reached.

It is obvious from the results just recorded that the magneto-optic method was not a success in our hands. The most scrupulous care was taken to make the apparatus an exact duplicate of the one developed by Dr. Fred Allison. One of us (A. C. S.) spent two weeks in Dr. Allison's laboratory working intensively under his direction with the magneto-optic apparatus. We take this opportunity to express our gratitude to Dr. Allison for his kindness and helpfulness; we must repeat, however, that in our hands the method proved to be a complete failure.

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CONTINUOUS PHYTOPLANKTON COLLECTION

IN the marine phytoplankton investigations of the inshore and inland waters of the northeast Pacific the problem of the localizations of growth of various genera and species of pelagic diatoms is often encountered. In an effort to obtain an idea of this "patching of the phytoplankton" and a continuous picture of the geographic localization of the plankton communities, it became necessary to devise a scheme for collecting plankton from a vessel underway.

The research vessel *Catalyst* of the University of Washington Oceanographic Laboratories has a seacock two meters below the water line just forward of the point of greatest beam. From it a pipe line is led to a convenient point below the water line in the ship. Here the water is filtered through the apparatus described below to collect the plankton.

The figure shows a diagram of the apparatus which consists essentially of a net (g) surrounded by a

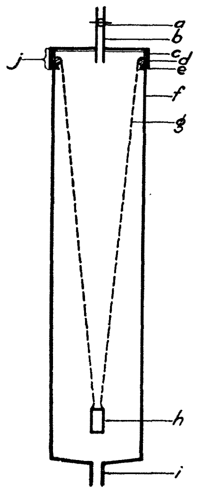

FIG. 1.

brass cylinder (f) to protect the net and to receive the filtered water. The inlet (b) brings the water from outside the ship's hull and the outlet (i) delivers the filtered water to the ship's bilge. The net, of 25 X bolting silk, is fastened in the usual manner by a canvas head to a brass ring (d) which rests on four lugs (e) to support the net in the cylinder. A cover (c) with a close-sliding joint at (j) permits the opening of the cylinder to change nets when necessary.

One may start using the apparatus at any time by allowing water to flow through the net at a desired rate and, since the head of water pressure between the valve (a) in the inlet and the surface of the sea is fixed, a uniform rate of flow is obtained when the vessel is underway except in a heavy sea. Thus the collecting time and the rate of flow give a close approximation of the quantity of water filtered. At given intervals the nets are quickly changed in the cylinder and the plankton collected is washed down into the plankton bucket (h), transferred to containers and preserved for further investigation of the volume, population and distribution of the various forms. This procedure allows a continuous collection of the surface plankton in any body of water through which the vessel may pass.

The size of the apparatus may be altered to permit the collection of the quantity of plankton desired in any given length of time by changing the rate of flow of the sea water and the filtering area of the net. In the apparatus used by the writer for phytoplankton the six millimeter inlet permitted the flow of two liters of sea water per minute and it was filtered through a 25 X silk net in the shape of a right cone with a radius of five centimeters and a height of thirty centimeters. The largest quantity collected during a twenty-minute period was thirty-six cubic centimeters of sedimented plankton, measured in a graduated cylinder after allowing sedimentation for three days. It was found that a representative qualitative and roughly quantitative collection of the surface phytoplankton could be made by this method.

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SPECIAL ARTICLES

ELECTRICAL EXCITATION OF THE NERVOUS SYSTEM—INTRODUCING A NEW PRINCIPLE: REMOTE CONTROL. PRELIMINARY REPORT[1]

A BRIEF description is given herein of an apparatus designed for the purpose of removing the restrictions of time, anesthesia and restraint from experimental exploration of functions susceptible to electrical excitation. It provides a wide range of control of current, frequency and of the individual wave contour.

In this method a small secondary coil, usually of 2,000 turns of copper wire, is actually implanted in an animal and one or both of its electrodes are taken to excitable centers. The wound is closed and after the animal recovers he is placed within the magnetic field created by a specially designed primary circuit. Two systems have been provided. One is intended for experiments of short duration in which the operator can maintain the position of the secondary coil parallel to that of the primary. The other consists of three primary coils set at right angles to each other, and the discharges are commutated successively through each of these coils, so that an animal placed in a cage within the coils receives a fairly uniform intensity of stimulation, no matter what position he may assume with respect to the coils.

In the single-coil system direct current, variable up to 450 volts, charges a bank of condensers of 80 microfarads' capacity, and these are discharged by means of a special mercury-pool tube through a primary coil of one to five turns which has a diameter of 36 inches. In the case of the triple-coil system a wooden box is built within the coils of sufficient size to accommodate a monkey for periods of several weeks, and his movements about the cage are attended by surprisingly small variations in the intensity of stimulus. Control is provided for a wide range of the frequency of discharge (from impulses separated by intervals of several seconds, to frequencies of 100 impulses or more per second); for voltage regulation; and for variations of the tuned

[1] From the Research Laboratory of Physics, Harvard University, and the Research Laboratory of the Department of Surgery, Yale University School of Medicine.