tilizer instead of a toxic salt to plasmolyze the weeds. By so doing the surrounding grass would be stimulated after the weed was killed and after the fertilizer had been washed away sufficiently from the point of application to reduce it to a concentration that is non-plasmolytic.

Each spring, for several years, this spotting procedure has been practiced. As much sulphate of ammonia as can be held between the fingers and thumb is placed on the crown of the weeds. As Grimmett reported, weeds so treated die quickly and completely. The grass surrounding the weed dies also, but in no case is the circle of dead grass so large as one foot across, as Grimmett reported sometimes occurs from the use of the toxic salt. Shortly the growth of the grass bordering the circle is tremendously accelerated so that within a few weeks the whole bare spot is covered with a thrifty growth of grass.

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SPECIAL ARTICLES

CAPACITY OF CONDENSERS IN SERIES

THE object of the present note is to show that the conventional formulation for the total capacity of electrical condensers joined in series or cascade is unnecessarily inexact. The formulation referred to is: The reciprocal of the total capacity of any number of condensers connected in series equals the sum of the reciprocals of the discrete capacities of all the individual condensers. The cause of the inexactness of the formulation lies in the fallacious idea which is brought out typically in the following quotation from a generally excellent book: "Since the outflow from one condenser constitutes the charge on the next, the charge Q on the positive coating of each must be the same and equal to that communicated to the first condenser." This premise was found by me to be involved, either explicitly or implicitly, in all the relevant books, save one, which were accessible in two libraries. By no means are all these books elementary texts; on the contrary, the names of several of the most noted living Dutch, English and Russian physicists are to be found on the respective title-pages. The exceptional book is by E. Mascart and J. Joubert (tr. by E. Atkinson), entitled "A Treatise on Electricity and Magnetism." A qualitative hint at the correct state of electrical distribution is given on page 72 of the first of the two volumes.

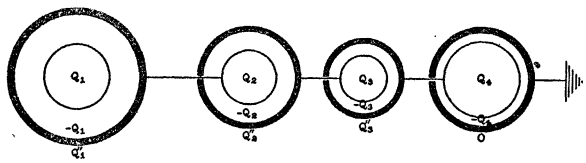

FIG. 1

It will be sufficiently general for the purposes of this note to outline the proof of the rigorous formula for the case of four spherical condensers connected by ideal wires of infinite length and zero capacity, as suggested by the accompanying diagram. The radii of the central sphere, of the inner surface of the concentric shell and of the outer surface of the shell will be denoted respectively by r_1, r_1' and r_1'', for the i^{th} condenser ($i=1, 2, 3, 4$). The corresponding charges on these three surfaces are Q_1, Q_1' and Q_1''. $1/C_1 = \kappa(1/r_1 - 1/r_1')$ and $C_1'' = r_1''$. The charge Q_1 is at the potential V_1 and the outside of the fourth condenser is "earthed." Then the following conditions must be fulfilled:

$$\begin{aligned}
V_1 &= Q_1/C = Q_1/C_1 + Q_1''/C_1'' \\
&- Q_1 + Q_1'' + Q_2 = 0 \\
&- Q_2 + Q_2'' + Q_3 = 0 \\
&- Q_3 + Q_3'' + Q_4 = 0 \\
&Q_1''/C_1'' = Q_2/C_2 + Q_2''/C_2'' \\
&Q_2''/C_2'' = Q_3/C_3 + Q_3''/C_3'' \\
&Q_3''/C_3'' = Q_4/C_4
\end{aligned}$$

Elimination of all the Q's from the preceding equations leads to the following general type of continued fraction:

$$\frac{1}{C} = \frac{1}{C_1} + \cfrac{1}{C_1'' + \cfrac{1}{\cfrac{1}{C_2} + \cfrac{1}{C_2'' + \cfrac{1}{\cfrac{1}{C_3} + \cfrac{1}{C_3'' + C_4}}}}} \qquad (1)$$

The way in which the various capacities are involved in formula (1) is instructive and interesting. Formula (1) can not reduce rigorously to the conventional equation

$$1/C = 1/C_1 + 1/C_2 + 1/C_3 + 1/C_4 \qquad (2)$$

unless $C_1'' = 0$, and this is impossible since the outside radii of spherical condensers can not vanish. Incidentally

$$Q_4 = Q_1 - (Q_1'' + Q_2'' + Q_3'')$$

so that Q_4 can not equal Q_1, since the parenthetical trinomial is always finite.

Although the goal of this note has been reached already in the above theoretical deductions, it seems desirable to give some numerical data in order to show the order of magnitude of the charges and errors.

Let all the condensers be identical with $r_1 = 10.00$

cm, $r_1' = 10.20$ cm, $r_1'' = 10.25$ cm and hence $C_1'' = 10.25$ e.s.u. and $C_1 = 510$ e.s.u.

Case 1. $\kappa = 1$. Then $100Q_4/Q_1 = 89.08\%$, $100\ Q_3''/Q_1 = 1.79\%$, $100\ Q_3/Q_1 = 90.87\%$, $100\ Q_2''/Q_1 = 3.62\%$, $100\ Q_2/Q_1 = 94.48\%$, $100\ Q_1''/Q_1 = 5.52\%$. Formulas (1) and (2) give $C = 136.207$ and $C = 127.5$ respectively, hence the error of equation (2) is about -6.4% in this special case.

Case 2. $\kappa = 80/17 = 4.706$ (paraffin oil). $C_1 = 2400$ e.s.u. $100\ Q_4/Q_1 = 97.49\%$, $100\ Q_3''/Q_1 = 0.42\%$, $100\ Q_3/Q_1 = 97.91\%$, $100\ Q_2''/Q_1 = 0.83\%$, $100\ Q_2/Q_1 = 98.74\%$, $100\ Q_1''/Q_1 = 1.26\%$. Formulas (1) and (2) give $C = 608.915$ and $C = 600$ respectively, hence the error of equation (2) is now about -1.5%.

In conclusion, attention may be called to the fact that it can be shown, by paying special attention to the definitions involved, that the general ideas presented above can be extended to the case of parallel-plate condensers.

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FURTHER OBSERVATIONS ON ADRENALECTOMIZED CATS TREATED WITH AN AQUEOUS EXTRACT OF THE SUPRARENAL CORTEX

IN a brief communication which appeared in this journal a few weeks ago (SCIENCE, 71: 321–322, 1930) the writers described the preparation of an active extract of the suprarenal cortex which maintains bilaterally adrenalectomized cats in normal condition. At the time of publication our oldest experimental animals had been under observation eighty days. Several of our treated cats recently reached their one-hundredth day of survival and were in excellent condition at that time. They all showed steady weight increases and could not be distinguished by their behavior from unoperated control animals.

At present we have no idea how long cats so treated will survive, since none of the animals receiving extract has presented symptoms, and so far as we know to the contrary they would survive indefinitely. However, when the animals reach the hundredth day of survival administration of extract is discontinued, and in every case tested death from adrenal insufficiency results within ten days. The onset of symptoms is abrupt, more so than in adrenalectomized cats not receiving treatment. Autopsy reveals the same findings as observed in untreated animals dying of adrenal insufficiency. The fact that the long surviving cats invariably die with typical adrenal insufficiency symptoms following cessation of treatment demonstrates conclusively that it is the extract which keeps them alive and in good health, and that no question of accessory cortical tissue is involved. We have used chiefly male cats in our survival experiments.

The following table shows the weight changes in a typical experimental cat. The striking weight loss which follows withdrawal of treatment is characteristic of all our animals.

TABLE I

No. 1 MALE				
Dec.	16	3160	grams.	R. adrenal removed.
Dec.	24	3185	"	L. adrenal removed. Treatment started Dec. 25.
Jan.	28	3320	"	
Feb.	12	3300	"	
March	5	3420	"	
March	12	3500	"	
March	22	3765	"	
March	30	3820	"	
April	3	3835	"	Extract discontinued. Animal in perfect health.
April	7	3630	"	
April	8	3610	"	Symptoms of suprarenal insufficiency.
April	9	3515	"	Symptoms of suprarenal insufficiency.
April	10	3400	"	Marked symptoms.
April	11	3355	"	Prostration, death.

Recently we have completed a series of experiments in which the adrenalectomized animals were not treated until adrenal insufficiency symptoms had developed, such as total anorexia, weight losses of several hundred grams and weakness in limbs so that the animal swayed unsteadily when walking. By injecting subcutaneously 2 cc of cortical extract three times daily, we have been able to bring such cats back to normal health, with complete disappearance of all symptoms of adrenal insufficiency. Following return to normal the animals are then given the regular treatment of 0.5–1 cc of extract per kilogram of body weight daily. This is an arbitrary dose since the minimum dosage has not been determined. We have several such animals in the laboratory which have returned to normal and are now in their fiftieth day of survival.

It is interesting to note that the disappearance of adrenal insufficiency symptoms is a fairly slow process and requires from four to five days of treatment. The maximum quantity of fluid given in twenty-four hours to any one cat showing symptoms is six cubic centimeters. This amount can be cut in half by further concentration of the extract and the results are the same.

It has been found that the fractions containing the cortical hormone can be conveniently and safely