Probably no one will deny that it is more convenient to adopt the plural form exclusively for such writing, for one may then head a table "potential, volts" without committing an error when some of the figures are fractions or are negative. Another advantage is in the use of abbreviations; one may write *g* for *grams,* and not bother about *g* or *gm* for *gram* and *gs* or *gms* for *grams.* We should be pleased, then, if a justification has been found for the almost universal practice of using the plural form exclusively.

Dr. Waters objects to "occurs at every 2×10^3 collision" on the grounds that one would not write "at every two collision." Now we can easily write "at every second collision" or at "every fiftieth collision," because there is a well-known terminology for the small ordinal numbers, but for the large ones this is not true. Dr. Waters assumes that in this example 2×10^3 is used in its numeral sense: I prefer to take it in its ordinal sense. Should one write 7.2×10^a *d* or 7.2×10^a *th*? Either is awkward and apt to be misunderstood, so why not use 7.2×10^a for either the ordinal or numeral sense when there can be no ambiguity? The same is being done with small numbers; we see a street sign marked "38 street" and read it "thirty-eighth street."

An offense worse than misusing singular and plural forms in naming units is not to use either one, so let us hope that no one will be so fearful of blundering in the singular and plural that he choose to omit any name whatever.

While on the subject of plurals I should like to mention the perplexing problem of forming the plural of symbols. In dealing with equations involving x_1, x_2, x_3, . . . , when one wishes to speak of them collectively, it is probably easy enough to write "the x_i's in eq. (3)," but if these quantities had been denoted by $A'_1{}^2$, $A'_2{}^2$, $A'_3{}^2$, . . . or some other complicated symbols, plurals formed with the apostrophe and *s* would be clumsy. A practice that seems proper, is surely advantageous and deserves wider use is to omit any sign of plural form and simply write "the x_i (or $A'_i{}^2$) in eq. (3)." Many nouns do not add *s* or change in any way in the plural, so there is nothing peculiar in mathematical symbols behaving the same way. In some foreign languages the modifying article is different in its singular and plural forms and the mathematical writer profits by it. In English it seems best to use the symbol without change in the collective sense, and charge the offense, if there be any, to the deficiencies of our language.

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THE ACCUMULATION OF STRONG ELECTROLYTES IN LIVING CELLS

RECENT uncritical discussion[1,2,3] of the relative validity of the two hypotheses as to the mechanism of selective accumulation of ions by living cells merits rectification. We refer to the "molecular hypothesis" (Osterhout) and the "ionic exchange" hypothesis (Brooks).[4,5,6] Osterhout's criticism of the ionic exchange hypothesis is self-contradictory, illogical, or based upon distorted interpretation, and he does not discuss certain serious weaknesses of his own molecular hypothesis.

Specific details being incompatible with the space limitations of the present communication, attention is called to the following condensed comparison.

(1) No test permitting *experimental* discrimination between the two hypotheses has yet been applied. Experimental alteration of intra- or extra-cellular pH does not constitute such a test. Disagreement between observed and calculated rates of ion intake when the basic assumptions are changed in the middle of the calculation (*i.e.,* after numerical values for relative permeability to different ions are reached) proves nothing as to the relative validity of the two sets of assumptions.

(2) No non-aqueous solvents[7] have to my knowledge been shown to be more permeable to KOH than to NaOH, as apparently demanded by Osterhout's molecular hypothesis. On the other hand, divers artificial and natural membranes which are selectively permeable to cations do show such a difference as regards K^+ and Na^+, and so do many if not most living cells. Analogous anion permeable membranes resemble living cells in showing little differential permeability to different univalent anions. The ionic exchange hypothesis thus has well-established experimental analogs, which are entirely lacking for the molecular hypothesis, which has so far offered no rational explanation for the highly selective absorption of ions by living cells.

(3) The molecular hypothesis fails to explain why K in the form of KCl molecules does not pass out of the cells used by Osterhout faster than it goes in as KOH. Using Osterhout's formulations we deduce as necessary to his hypothesis the following assumptions:

a. That KCl is about 50,000,000 times more disso-

[1] W. J. V. Osterhout, *Jour. Gen. Physiol.* 14: 277, 1930.

[2] W. J. V. Osterhout, *loc. cit.,* 14: 285, 1930.

[3] A. G. Jacques and W. J. V. Osterhout, *loc. cit.,* 14: 301, 1930.

[4] S. C. Brooks, *Proc. Soc. Exp. Biol. Med.,* 27: 75, 1929.

[5] S. C. Brooks, *Protoplasma,* 8: 389, 1929.

[6] S. C. Brooks, In *Contributions* to Marine Biology, Stanford University, California, 1930.

[7] Exception being made of selectivity ion-permeable membranes which may be regarded either as porous solids or as non-aqueous solvents (see Brooks[6]).

ciated in aqueous solution than is KOH, or

b. That the diffusion constant of KOH in the hypothetical non-aqueous medium bounding the protoplasm is 50,000,000 times that of KCl, or

c. That the two factors combined account for the 50,000,000-fold difference.

Such assumptions would be purely *ad hoc* and without experimental basis or parallel.

(4) Until 2 and 3 above are satisfactorily explained the molecular hypothesis must be regarded as untenable.

The detailed answer to Osterhout's criticism and a fuller explanation of the above points will be published in another journal.

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A CURIOUS COLOR PHENOMENON

WHILE experimenting with an intermittently flashing neon discharge tube, the writer observed a phenomenon which may thus far have escaped being reported, if not observed, by others. He has demonstrated it to a number of persons, all of whom agree upon the description of what they perceive. Whether the effect is subjective or objective is not definitely established, but it appears to be purely objective.

A neon tube about 4 meters long, made of 8 mm glass tubing, is bent in the shape of a grid, so that a rectangular area 25 x 35 cm is covered by the parallel portions of the tube, which are spaced about 2 cm between centers. The tube is supported in a frame-like box, backed by a reflector, and covered in front by a ground glass panel. The illumination from the tube is somewhat diffused, but the shape of the tube is distinguishable through the ground glass. The tube is flashed by the high voltage from the secondary of a transformer, giving about 10,000 volts maximum when a direct current through the primary circuit is interrupted. A mechanical device is employed to make and break the primary at any desired frequency up to twenty-five per second.

At the upper frequencies, the light appears nearly continuous, the color being that which has become so familiar through the neon advertising sign. As the frequency is gradually decreased, flickering becomes pronounced at about twenty flashes per second, without change in color. The duration of the flash is very short, but its time has not been determined. If the observer looks directly at the ground glass when the frequency reaches twelve or ten flashes per second, there appear around the edges of the screen bright fringes of color—blue, green, bright red and yellow—colors quite different from the normal color of the tube. The interplay of colors becomes more striking as the frequency is further decreased. They shift and dance about, and at a frequency of about seven they flash and flicker over the entire illuminated screen, with the regular neon color predominating as a background. The colors observed are vivid and unmistakable. At a frequency of three or four flashes per second the varying colors disappear and only the characteristic neon color remains.

If an electric fan is set in operation in front of the "neon screen," and the frequency of flashing adjusted so that there is apparently slow rotation of the fan, the edges of the blades are outlined with the "dancing" colors. The colors observed do not appear in the lines of the spectrum.

A neon tube bent in the form of a flat spiral, and without a ground glass diffusing screen, has been found to give similar effects.

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THE AUTO-TRACTION HYPOTHESIS OF CRUSTAL DYNAMICS AND MECHANICS

THE department of geology, University of Manitoba, has a paper in the press which presents a preliminary outline of an hypothesis of crustal dynamics and mechanics. It introduces the conception of a sheet-flow in the crust of the earth, similar to that in ice-sheets. It calls into play the translation of all available geological energy into the great forces that have effected the geological changes of the past and elucidates a mechanism that seems to throw new light on most of the major crustal phenomena.

The paper will be issued shortly in pamphlet form as a contribution from the department of geology, University of Manitoba, Winnipeg. Any one interested in the hypothesis may communicate with me at this address and a copy of the paper will be mailed as soon as it comes from the press.

J. S. DELURY

SCIENTIFIC BOOKS

Atlas Céleste. By E. DELPORTE. Cambridge University Press, London; Macmillan, New York, 1930.

LAST year Dr. Delporte, of the Royal Astronomical Observatory at Uccle, Belgium, set down new boundaries of the constellations as arcs of hour circles and parallels of declination. He did this work at the recommendation of the International Astronomical Union. Its successful completion was a remarkable example of international cooperation. This work