tion phenomena, but clearly they are not such as to permit of the simple interpretation given, as even casual consideration of their nature will reveal. It is assumed, for example, that K is precipitated in the living cells through its interactions with the chemical constituents in those cells so as to permit the constant flow of K in solution into the cell from the medium. But any one who has studied the composition of cell sap from a variety of plants can not help but be impressed by the enormous quantities of soluble (not precipitated) K salts which the sap contains and, in all likelihood, in the form of *simple dissociated chemical compounds.* The data obtained on kelp and on other algæ, and those obtained by Kostychew and Eliasberg[5] on other plants, as well as unpublished data recently obtained by Hoagland on cereals, and by Hoagland and Davis on Nitella (a plant used by Osterhout in permeability studies), support the significance and cogency of this statement. Since space forbids our considering several examples, let us study the results on Nitella. This simple alga absorbs K readily from exceedingly dilute solutions thereof and from solutions having a high p_H value to a region within the cell of lower p_H value. This, in itself, proves Mr. Truog's assumption to be fallacious. Hoagland and Davis have found further, in agreement with Osterhout and Crozier that that alga lives in a medium whose p_H varies from 7.2 at night to 9.4 during the day, yet the hydrogen ion concentration of the vacuolar sap of that plant is represented by an approximately constant value of p_H 5.2. Further, Nitella lives in a solution whose Cl content varies from 20 to 30 p.p.m., yet the vacuolar sap of the alga has a Cl concentration of approximately 3,500 p.p.m. Moreover, in suitable media, all the Cl may be taken up by the alga and yet none will pass out of the cell unless the latter is injured, or the normal permeability is changed. Does this in any way support the attempt to apply the law of mass action to absorption of ions by plants after Truog's concept? The general principles gleaned from the work with Nitella should be applicable to plants generally.

[5] Hoppe-Seyler's Ztschr. physiol. chem., Vol. III, pp. 228-235 (1920).

It is, of course, regrettable that this review must be curtailed and that, therefore, a fuller discussion can not be accorded the points which are considered above, and some discussion to important ones which have not been mentioned. Enough has been said, however, to indicate the insecurity of Mr. Truog's theory and of the assumptions upon which it is based. The indications from recent research are that the reaction of plant sap in nearly all plants that have been investigated varies only in a very narrow range (Haas' work on natural indicators being exceptional), and that the conclusion that the ability of plants to absorb K from their media depends on the reaction of the cell sap and that sap of a high p_H permits plants to absorb K more efficiently from dilute solutions thereof than that of a low p_H are probably erroneous.

We may mention, further, in passing, that experimental evidence has been adduced in this laboratory to show that plants do not require Ca in the form of carbonates or bicarbonates since they can grow in solutions so acid that such compounds can not exist to the extent considered necessary.

Finally, we may say in closing that the term "feeding power of plants" is not only insecure, because of its vague support in fact, as partly indicated above, but also because absorption of ions is in no correct sense a feeding by plants and the sooner we give up referring to the mineral elements in soils as plant foods and of speaking of culture solutions as nutrient solutions, the better it will augur for the attainment of that clarity of expression, as well as thought, which are requisite to constant progress in plant physiology, as in other sciences.

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THE PERSONAL EQUATION OF THE ASTRONOMERS

THE data reported by Tucker in his communication on "Reaction time and fatigue"[1]

[1] Tucker: SCIENCE, LVII, No. 1468, February 16, 1923, pp. 204-5.

does, as he supposes, interest psychologists, but mainly because his results fall within the range of details which have been pretty thoroughly worked out by psychologists. Burrow's monograph[2] contains the best historical account of the investigations up to 1909, and very little has been done on the problem since the publication of my own articles in 1910.[3]

Although the causal factors have not yet been precisely determined, certain points are clearly settled. First, the "personal equation" is not a matter of [illegible] at all, but a matter of the [illegible] of reactions and anticipated stimuli. Simple reactions to visual stimuli are seldom shorter than 100σ (0.1 sec.), whereas the errors in synchronization are usually much smaller and frequently negative. The errors fall within the limits of the imperceptible time interval for the conditions of observation. Second, the usual error, without practice, is negative, and practice tends to change it towards the positive. Third, the same phenomena appear under conditions in which no overt reaction is required, but in which, as in the astronomer's eye-and-ear method and Wundt's complication experiment, the subject is required merely to note the apparent position of a moving object with reference to a series of auditory stimulations. And we are now safe in saying that this is because the latter cases are of the same type as the former, that is, that a discriminative perception is really a reaction: and this in a literal, not a figurative sense.

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QUOTATIONS

COPERNICUS

THE whole world should observe along with the Poles the birthday of Copernicus, and should continue to celebrate the 19th of February in his memory so long as the earth swings in its orbit; for what this boy, born 450 years ago, and christened Nichola Koppernigk, son of a native of Cracow, conceived as the order of the universe is "the capital event of modern thought." By it mankind's outlook on the universe has been fundamentally changed. The young Koppernigk was a student in the University of Cracow the year in which Columbus discovered America, giving himself to mathematical science and painting. He afterward studied law and attended mathematical lectures in Bologna and still later studied music in Padua and took his degree in canon law in Ferrara. He then devoted his medical skill to the service of the poor, his economic knowledge to the reform of the currency in the Prussian provinces of Poland, and his astronomical genius to the development of a new cosmic theory which has come to bear his name.

It was while he was in the midst of such studies and ministries that the name "America" was first given by others to the fringe of this continent and graven on a map published at St. Dié, at the foot of the Vosges Mountains, in southeastern France. Our continent was thus christened under the Ptolemaic geocentric system. But our national life made its beginnings under the Copernican system and had from the first a "shuddering sense" of physical immensity. It is inconceivable that this new physical conception has not mightily affected man's social and religious conceptions, and especially those of Americans. With the enlargement of the universe under it, and the accompanying diminution of the relative size of the earth—made still smaller by man's improved means of communication—we no longer picture our planet as a flat area divided into exclusive, provincial or national strips spanned by a Ptolemaic sky. We find ourselves "in the same boat" on a sea of practically infinite space.

In observing the birthday of Copernicus the Polish astronomers have fitly gathered in their first congress and proudly remembered what their science has given to mankind; and the Polish people have with good reason held their celebrations all over Poland in honor of the son of the city of Thorn (now again in Polish territory) and the academic son of the

[2] Burrow: "The determination of the position of a momentary impression in the temporal course of a moving visual impression. *Psychol. Monographs*, XI, No. 4.

[3] Dunlap: "The complication experiment and related phenomena," *Psychol. Review*, XVII, pp. 157-191; "Reactions to rhythmic stimuli with attempts to synchronize," *Psychol. Review*, XVII, pp. 399-416.