of the planets and satellites of our solar system and the periods of revolution of visual binary stars. More than an accidental number of preferences for the same periods were found in a variety of these motions. In addition it was found that there was a tendency in many if not all of them for the periods to fall into series and sequences of one half or two times the adjacent periods.

The binary stars also showed preferences for certain periods, and—what was the most astonishing of all—there appeared to be some kind of correlation between these periodic phenomena and the atomic weights of the elements.

In a paper "On the Nature of Stellar Variability"[1] were published some of the results for the different classes of variable stars and reference was made to preliminary examination of the planets and satellites of the solar system. The results for the binary stars and the apparent correlation with atomic phenomena have not yet been published.

It is not possible to give here the evidence on which the relationships referred to rest, and circumstances over which I had no control have prevented up to the present further prosecution of those investigations or attempts to publish them. I hope to go further with this work and to publish what has already been done. Time has not weakened the strength of the data.

Briefly, the correlations referred to are between the periodic phenomena of widely divergent kinds, such as pulsations in stellar envelopes and orbital periods, and these in turn with atomic phenomena. Such correlations, if real, must have some kind of underlying relationship of a very fundamental nature. Although the mechanism and the steps are not evident, the idea is at once suggested that some form of motion may be the link, that here we may be encountering the relationships between mass and energy or motion, or perhaps simply transformations of energy. Such apparent relationships recall the speculation that matter is only frozen motion.

These correlations, if general, would imply an intimate relationship between widely differing units, such as the day, year and atomic properties. It is to be remembered, however, that these all reduce to time and motion.

The transformation of matter into energy appears to be satisfactorily established, and with the cosmic rays indicating the building up of atoms, it seems no far cry to a relationship between atomic motions and those of large aggregations of atoms. The law of gravity applies to the smallest meteoric particle as well as to the largest star.

For the present I can do no more than call attention to these periodic phenomena and their possible bearing on some of the fundamental problems of cosmogony. To the future must be left the final decision as to their reality and their nature.

CORDOBA, ARGENTINA, OCTOBER 30, 1928 C. D. PERRINE

[1] *Ast. Nach.*, 5505, Band 230, 1927.

RESONANCE RADIOMETRY

THE limiting sensitivity of any radiometric system is reached when spurious deflections become comparable with real deflections. Beyond this point optical magnification, increased period, etc., are of no avail. An attempt is here made to reduce the relative effect of spurious disturbances by causing the radiations from a real source to be intermittent with a definite period, and to "tune" the entire system to be period of intermittency. The system, though not limited to any definite radiometric device, does make use of the principle of resonance—hence the name "resonance radiometry."

To be specific: a single-junction thermopile (I) of the type developed by the writer was exposed to radiation at intervals of 0.75 seconds by means of a pendulum having a period of 1.5 seconds. The thermopile (I) was connected to a low-resistance, underdamped D'Arsonval galvanometer (I) tuned to a period of 1.5 seconds. A concave mirror attached to this galvanometer made it possible to project the image of a coarse grid (consisting of bars 2 mm wide and 2 mm apart) on a second grid of the same spacing. This second grid was "split" centrally so that the image of the first grid, when in motion, would increase the amount of light transmitted on one side and decrease the light on the other side. By means of a split lens, the light passing through the second grid was brought to two foci on the respective junctions of a three-element compensating thermopile (II), also of small heat capacity. This thermopile (II) was connected to a second D'Arsonval galvanometer (II) having the same period of 1.5 seconds. The light falling on thermopile (II) was derived from a small auto headlight lamp.

Both galvanometers were of rugged construction and of relatively low sensitivity. Due to the circumstance that the entire system was "tuned," a high degree of immunity from spurious (non-intermittent) disturbances was realized.

The sensitivity actually obtained is as follows: With a candle at one meter from thermopile (I), the radiation passing through an aperture of one square millimeter at the above distance occasioned a deflection of 2,000 mm on the meter-scale of galvanometer (II). This sensitivity already rivals that of the best instruments now employed.

In later experiments, thermopile (II) was replaced by a vacuum-tube amplifier embodying a photoelectric cell. By means of this, the above sensitivity was increased, approximately 1,000 times. At the present time, efforts are being concentrated on imparting to galvanometer (I) the great stability which is essential to high amplification.

A. H. Pfund
The Johns Hopkins University,
December 28, 1928

HALL EFFECT IN SINGLE METAL CRYSTAL

In Science for August 24, 1928, a report on measurements of the Hall Effect in single crystals of silicon steel stated that no change in this effect with change in crystal orientation had been found. It was further stated that such changes probably should not be expected in metals following the cubic lattice structure but might be expected in some other structure. Recently measurements have been made on a large zinc crystal of the close packed hexagonal system and the Hall Effect was found to be about 50 per cent. larger in the single crystalline portion than in the polycrystalline portion.

P. I. Wold
December 12, 1928

DISSOCIATION OF NEUTRAL VACCINE VIRUS–IMMUNE SERUM MIXTURES

It has been shown that the mixture of a virus and its specific anti-serum which is innocuous when introduced into the animal organism becomes disease-producing after dilution with appropriate amounts of Ringer's solution.[1,2] Certain aspects of this reaction have led us to conclude that the dilution phenomenon resembles the hydrolysis of the salt of a weak acid and weak base, and that the observed dissociation probably follows the law of mass action. This is indicated by results obtained from qualitative studies of the degree of dissociation following dilution of neutral and over-neutralized mixtures of vaccine virus and immune serum, from cataphoresis experiments, and from the observation that the dissociation is reversible.

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PRICKLY PEAR WORK

In Science for September 14, page 241, there is a reference to a paper contributed by Dr. R. J. Tillyard to the Fourth International Congress of Entomology. This appears to imply that the work on entomological control of prickly pear in Australia has been carried out by Dr. Tillyard himself, though I am sure that he had no intention of conveying such an idea when presenting his paper.

As the prickly pear work in Queensland is attracting considerable attention and promises to be highly successful, it might be worth while just briefly to place on record the history of its control.

The first step was taken in 1912 when, at the instance of the Queensland government, Dr. T. Harvey Johnston and Mr. Henry Tryon spent eighteen months visiting various parts of the world where prickly pears exist, investigating the natural enemies of the plant. As a result the Indian cochineal was introduced and rapidly destroyed the smooth tree pear, *Opuntia monacantha,* in the districts where it occurred. The pest pears (*inermis* and *stricta*) were least affected. In 1919 the governments of the Commonwealth, New South Wales and Queensland entered into a cooperative agreement and for five years carried out experiments to determine thoroughly the possibilities of biological control. The Commonwealth Prickly Pear Board was constituted in 1920 to undertake the work, and the agreement between the three governments was renewed in 1925 and again two years later. It expires on May 31, 1930. The present members of the board are: Mr. F. D. Power, chairman of the Queensland Prickly Pear Commission; Mr. G. D. Ross, under secretary for agriculture, New South Wales; Mr. Gerald Lightfoot and Professor E. J. Goddard, representing the Commonwealth Council for Scientific and Industrial Research. The annual vote available to the board has recently been increased, and now amounts to £18,000 per annum, of which the Commonwealth provides half.

The scientific work was under the control of Professor T. Harvey Johnston from the inception of the board to February, 1923; of Mr. J. C. Hamlin from then to May, 1924; of Mr. W. B. Alexander from that date to August, 1925, while Mr. Alan P. Dodd has been in charge since October, 1925. Biologists are at work both in North and South America, and in Australia there is a central receiving laboratory and quarantine station near Brisbane and breeding and acclimatizing stations elsewhere in Queensland and New South Wales. The scope of the work includes:

(a) The study of all prickly pear insects in their native country.
(b) The breeding of material free from parasites and predators.
(c) The testing of these insects against crops and other plants.
(d) The forwarding of selected kinds of insects to Australia.
(e) Their breeding and acclimatizing under local conditions.
(f) Their establishment in the open at various localities on our several pest pears.

Numerous insects have been introduced, of which by far the most successful to date is *Cactoblastis cac-*

1 Todd, C., *Brit. Jour. Exp. Path.*, 1928, ix, 244.
2 Andrewes, C. H., *Jour. Path. and Bact.*, 1928, xxxi, 671.