DISCUSSION AND CORRESPONDENCE

WHEN DOES WINTER COME?

IN connection with the proposed thirteen-month calendar it has been suggested that the first day of the year should be December 22 so as to coincide with the beginning of the winter. A change in the year as a whole will be a very appreciable addition to the other inconveniences necessarily accompanying a change of calendar, and ought to be made in the most satisfactory way if the inconvenience is to be incurred at all. Moreover, at present some extra labor results when meteorological data for the different seasons are referred to dates which do not coincide with the beginnings of months. This trouble is wasted if the choice of dates is not a happy one. It therefore seems interesting to show that the not infrequent practice of beginning the seasons on the 21st or 22d of December, March, June and September (that is, at the solstices and equinoxes), is not only not the best but is actually worse, and a good deal worse, than to begin them with the beginnings of certain months.

The solstices and equinoxes are astronomical phenomena; the seasons are meteorological phenomena, governed by the astronomical events, but not coinciding with them. The winter solstice, for instance, the 21st or 22d of December, is astronomically not the beginning of winter at all, but the middle of winter. To use the middle of one kind of winter as the beginning of another kind has something illogical about it. If it should really be the case that the 21st of December were an appropriate beginning of the meteorological winter, the real, weather winter, a clear-headed person might even regard the coincidence as a cause of confusion and might feel moved to explain that there was a coincidence between two events which readily were of a different character. But if the meteorological winter does not begin on the 21st of December at all, then those who should assign its beginning to the 21st of December would be setting false limits to the winter in order that thereby they might begin it on an illogical and confusing date.

The only practical criterion of the meteorological winter appears to be the temperature. Since temperatures differ in different years and also in different parts of the temperate zone, the determination of the best dates for beginning and ending seasons is necessarily a statistical matter. For this statistical process, however, abundant data are at hand and a result can easily be obtained which, in view of the variations occurring in any one year, would generally be considered quite satisfactory. A curve which has been drawn for the climate of Washington probably coincides nearly enough with the average climate of the temperate zone as far as the beginnings and endings of the seasons are concerned to serve as an illustration here. According to this curve the average coldest day of the year is, within a day or so, the 21st of January; the average coldest 90 days runs from the 7th of December to the 7th of March. Similarly, the middle of summer is very close to the 21st of July, with the whole summer running from the 7th of June to the 7th of September.

It thus appears that by illogically tying up the beginning of one kind of winter with the middle of another, and by splitting months in meteorological calculations dealing with the seasons, we actually may be twice as far away from the real seasons of nature as if we counted those seasons from the first of December, March, June and September.

The practice of beginning the seasons with the solstices and equinoxes seems also to be in conflict with the prevailing usage of the past. The 21st of December, for instance, is called the *winter* solstice, which is an appropriate name if it comes within the winter astronomically and meteorologically, as it really does. But as the beginning of winter it has no right to this name. It thus would be the autumn-winter solstice.

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ELEMENTARY TEXT-BOOKS OF PHYSICS

HAS the text-book of college physics kept pace with the rapid strides which the science as a whole has taken? To be sure, in the revised editions of the older texts, one finds additional paragraphs dealing with twentieth century developments. Indeed, one recent book devotes the last fifth of its pages to the "new physics." But is not this segregation of the new material a confession that the treatment as a whole is from the old point of view? On my shelf there is a text-book of college physics copyrighted within the last year which has essentially the same table of contents as an edition of Ganot's "Physics" of over fifty years ago. Do not the customary subdivisions, mechanics, sound, light, etc., imply that still the physicist deals with the world of nature directly with his hands and ears and eyes? Is there not need to reorganize the treatment to better emphasize those fundamental relations and principles which, to be sure, appear to the senses in many varied forms, yet really constitute the science of physics from the modern point of view?

Many a college freshman who has been introduced to the subject-matter of physics from the practical point of view in a secondary school course has sufficient experience and background to be taken behind the scenes and shown the theoretical basis of the stage effects which he has witnessed. Let us consider the nature of a text-book written for this type of student.

Such a text must of necessity be analytical in character, although the formal mathematics used need be no more than that required for college entrance with the addition of the nomenclature of trigonometry. In order to show to the student that mathematics is really the language of the physicist, the book begins with a mathematical introduction. Geometrical optics, developed by the ray method from the principle of rectilinear propagation and the laws of regular reflection and refraction, illustrates the use of geometry and trigonometry. The vector idea is introduced by the statics of a rigid body. Finally, this introduction closes with a brief treatment of kinematics to bring before the student the idea of instantaneous rates of change and of the summation of varying quantities as shown by the slope and subtended area of velocity-time curves. Although no formal calculus is used, it is explained how average or effective values may be dealt with by simple algebraic formulae.

The material in the remainder of the book is grouped in the following parts:

(1) "Energy and steady fields." The concepts of energy, potential and fields of force are introduced with the field of gravity at the earth's surface which is considered as constant. Then the same ideas are applied to constant hydrostatic fields. Finally, universal gravitation, electric and magnetic attraction and electromagnetic radiation are discussed as inverse square fields.

(2) "Dynamics of a rigid body." The concept of inertia is introduced with a dynamical definition of mass. The parallelism between translational and rotational motion is emphasized.

(3) "Flow phenomena." Starting with the customary treatment of hydraulics, the analogy between the flow of water, heat, electricity, lines of electric displacement and magnetic flux is brought out.

(4) "Periodic phenomena." After pointing out the existence of a centripetal acceleration in circular motion with constant speed, the characteristics of simple harmonic motion are developed. It is shown that any system which follows a generalized Hook's law vibrates with this type of motion and often gives rise to a wave motion intimately related to it. Thus a great variety of phenomena from the fields of mechanics, sound, light and electricity is brought together on a theoretical basis and discussed with great economy of effort.

(5) "Kinetic theory." The actual mechanism behind these phenomena, which in the preceding sections are studied from the macroscopic point of view and considered as continuous, is here explained in terms of the motion of discrete electrons and molecules.

The whole development of the text is based on a rigorous set of definitions built up logically from five fundamental concepts—length, l, force, F, time, t, electricity, Q, and temperature. This group of fundamental concepts permits the use of a dimensional analysis which, in addition to checking the student's formulae and aiding him in changing units, gives a more concrete insight into the relations between the various concepts. For example, this analysis permits at once of the electromagnetic conception of light phenomena. Illumination is proportional to the energy which strikes a unit surface per second and thus has dimensions $[F\, t^{-1}\, l^{-1}]$. This radiant energy depends upon the product of the electric and magnetic field strength in the advancing light wave. The electric field strength, defined as the force per unit charge or as a potential gradient has dimensions $[F\, Q^{-1}]$. The magnetic field strength defined in terms of the magnetic effect of the current has dimensions $[Q\, t^{-1}\, l^{-1}]$. The product of these two field intensities is at once seen to have the same dimensions as the illumination.

In conclusion, if the aim of a physical science is to systematize our knowledge of the world about us, surely we should not be overwhelmed by the fascination of external phenomena but should look for general fundamental relations and deal with elementary college physics from the theoretical point of view.

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HONEY BEES AND PERFORATED FLOWERS

IN SCIENCE 62, 134, August 7, 1925, Professor Burrill states that honey bees got nectar of *Diervilla florida* through holes made by carpenter bees. The hive bee has been seen making holes in flowers of *Aquilegia vulgaris* (Sprengel 1793, Mueller 1873), *Erica tetralix* and *Nepeta glechoma* (Mueller 1873). It gets nectar from holes made by other insects in flowers of *Trifolium pratense* (Mueller 1873, Belt 1875, Darwin 1877, Pammel 1883), *Aquilegia vulgaris, Corydalis cava, C. solida, Diclytra spectabilis, Lamium album, L. galeobdolon, Melampyrum pratense, Symphytum officinale, Vicia faba, V. sepium* (Mueller 1873) and *Monarda fistulosa* (Robertson 1892).

Having observed 15,172 insect visits to 441 local insect flowers, I have found only four flowers perforated, and then only by *Leionotus foraminatus* and *L. dorsalis*. The following insects used the holes: on *Monarda fistulosa,* besides the hive bee, one *Ceratina,*