seeds of the various cereals which we group together as grain. The amount of such material produced from the soil in a year is almost beyond calculation. The production of this golden flood of grain is the earth's oldest and greatest industry. Besides the starch given us in the cereals we must not forget the potato which is another staple article of diet in the whole civilized world. In different countries various starchy foods are popular such as sweet potatoes, arrow-root preparations, tapioca, sago, chestnuts, bananas, etc. From the time that man first noticed that grains were good to eat he has taken plants of this type under his special protection and given them careful cultivation. The result has been an improvement in the races of grains as judged by their yield and adaptability to varying conditions of climate. To produce these harvests the soil supplies the water and mineral nutriments while the carbon dioxid and sunlight lend their aid through no effort of man. His duty, then, is to see that the soil is kept in its most productive condition and by so doing he will have an ample supply of grain for the needs of the future.

THE INDUSTRIAL IMPORTANCE OF STARCH.

The observation of primitive man that the seeds of certain plants made an acceptable food was the beginning of agriculture. Another observation made some time later was that when starchy materials were allowed to stand they underwent a peculiar transformation. The result of this change was a so-called "spirit" which was soon found to possess magic properties in making "glad the heart of man." This, then, was the origin of another vast industry whose object is the production of alcoholic materials through the fermentation of grains by enzymes and micro-organisms. Alcoholic beverages of one sort or another are known everywhere and their production goes hand in hand with the practice of agriculture. The amount of grain used by the brewing and liquor distilling industries comes to an enormous figure and is second only to that consumed as bread and various bakery products. The flour milling industries prepare starchy food for the millions, the example of the former in centralization is being followed more and more by the bakeries, especially in the larger cities. The preparation of bread in the home is becoming less common every year and most of this work is done in large bakeries where more or less scientific methods are beginning to prevail. Various forms of natural and prepared starch are employed in large quantities in the form of specially treated foods, laundry starch, sizings, adhesive pastes and so on in great variety. Very valuable products are manufactured by heating or treating raw starch in such a way that dextrins and gums are formed. These are used as adhesives and for other purposes. The action of dilute acid upon starch yields glucose and it is upon this reaction that another great industry has been founded. Glucose has a multitude of industrial applications and it also figures in our food, sometimes under another name but tasting just as sweet. Starch and its products are valuable in many other ways than merely those already mentioned but it would be presumptuous to point them out to this Section of our Congress.

In this paper the writer has not striven to give detailed discussions of any sort for these may be found in books on plant and animal physiology but has endeavored to present many old and a few new ideas in the way that they appear to one interested in the biochemical problems of plants and animals. For those desiring a closer insight into the phenomena of starch formation a short bibliography is appended. In these works full references to the original papers in this field may be obtained.

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A Simple Method of Determining the Time*

By Prof. William H. Pickering

WHEN it is only required to know the time within a second or two the following method of obtaining it, without instrumental aid, will be found a very satisfactory one. For certain classes of astronomical work, notably photography, and for many kinds of visual observations, particularly on the planets and brighter stars, this accuracy is all that is needed. When no other work is done at a station, so that the time observations are merely a means to an end, and not the end itself, or in the case of any amateur astronomer who is located far from a telegraph station, and wishes simply to know approximately what time it is, the following method of observation is recommended.

The object in my own case was to waste no time at night on time observations, which might better be applied to work that was worth while. If daylight observations were to be employed, the object must necessarily be the sun.

It was suggested to me by Prof. W. P. Gerrish that by using proper precautions, the time of transit of the shadow of a rod across a line ruled on a screen could be determined within a few seconds. This was found to be the case, and the question was then simply to find the best method of constructing a sun-dial.

A half-inch steel bar, eighteen inches in length, was supported horizontally upon Y's, which were capable of adjustment upon a cast iron base. This was set on the top of a concrete column six feet in height having a cement surface surrounding it. One end of the bar projected about six inches beyond the column. This could all, of course, be much simplified by the amateur who would be satisfied with somewhat less accuracy. By means of two plumb lines sighted on Polaris at upper culmination, it was possible to lay off a meridian with sufficient accuracy, and to mark it by means of screws driven into the flat cement surface at the base of the column. A pencil line was ruled between the slots of the screws. The amateur need only choose a time for sighting on Polaris when δ Cassiopeiae or ζ Ursae Majoris appears directly above or below it. Then by sighting from behind one plumb line upon the other the required meridian will be obtained.

A simple transit of the shadow cast by this rod across the meridian line gives the time of Apparent Noon, but better results are obtained by taking a piece of red paper pasted on a card or envelop, and dividing off its two longer sides into intervals of a quarter of an inch. The middle division is continued straight across the card. The divisions are numbered successively, and the middle division may then be placed so many quarters of an inch on either side of the meridian mark. By sliding the card along, we may in this manner obtain several transits of the shadow across this middle division, instead of only one, as if we used the meridian line directly. By taking five transits symmetrically distributed with regard to the meridian mark, it is found that the average deviation of a single transit is usually in the neighborhood of two seconds. The probable error of the mean would, therefore, be about one second, which is quite as accurate a result as could be obtained with a sextant, and entirely avoids the lengthy and troublesome computation necessary with that instrument. The red paper was selected as being less trying to the eyes than white, but shaded spectacles are also employed for further protection.

In the *Observer's Handbook*, pp. 6 and 7, will be found a column headed "Equation of Time," by which we may convert our Apparent Time directly to Mean Time. A further constant correction must be made for the longitude of the station, to convert to Standard Time, and that is the only computation needed to obtain our results.

While a horizontal bar has been employed in our latitude, + 18 degrees, it is probable that beyond + 45 degrees a vertical rod at a less elevation would give better results, at least, in the winter time. Another method would be to employ two walls lying east and west and situated about six feet apart. The sun shining through a small hole in the southern wall would cast its image on the northern one, and a vertical line ruled on this in the proper place as determined by Polaris would serve to mark the meridian passing through the hole. In the summer time the image would lie on the ground between the two walls. A modification of this plan has been used by Mr. Maxwell Hall, of Jamaica. It has the advantage over the shadow method, that the latter gives trouble when there are thin clouds passing over the face of the sun, the shadow shifting so that it is impossible to obtain a satisfactory result.

By any of these methods the systematic errors are the ones chiefly to be feared. In many places the chief of these would lie in the uncertainty as to the longitude of the station, and this error would affect the most refined instrumental observations equally with those above described. An error of one mile in the assumed longitude would introduce an error of about four seconds in our result, and the farther north we went the greater would this error become.

*Reproduced from the *Journal* of the Royal Astronomical Society of Canada.

Electromagnetic Waves

THE laws governing the propagation of radio-telegraphic signals in the atmosphere during the day and during the night are still but imperfectly known, and the development of aeronautics has enabled us to gather some interesting information on this subject. The signals grow weaker as the distance increases, but one of the points to be examined is to know how the height above the ground influences this problem; in other words, are the signals affected by a weaker density, a lower temperature, and by the intense ionization of the high regions of the atmosphere. M. G. Lutz has given several results obtained in utilizing a balloon of 1680 cubic meters, with a circumference of 45 meters. The antenna was formed by a metallic wire of 100 meters long hanging under the basket. During the experiments made in the night, the balloon covered a distance of 120 kilometers at an average altitude of 1,277 meters. It was found that the intensity of the signals received decreased when the distance increased, but that this weakening is not proportional to the square of the distance; it varies as the power 1.96 of the distance and when far from the starting station, as the power 0.88. At an equal distance it is remarked also that the signal is so much the weaker as the balloon is higher. To be more precise on this point, a second ascension was made, the balloon then rising to a height of 6,500 meters. At this height, the intensity of the signals equalled what they would have had on the earth at the same distance from the station. These results are worth being confirmed and completed, for the question is still but very incompletely known, and up till now the experiments have been insufficient.—*Chemical News.*

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