

ica have been made by conchologists. This perhaps explains the lack of morphologic description of the parasite from America prior to 1920 since it was only of passing interest to snail collectors. It would be splendid if men who have the opportunity to collect certain groups of animals would save and turn over the parasites and symbiotic animals to those interested in these particular fields, and certainly we would work out life cycles much faster if this attitude were taken by professional collectors.

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#### SOME SIMPLE GENERATORS OF HIGH FREQUENCY OSCILLATIONS

TO THE EDITOR OF SCIENCE: In SCIENCE for October 15 is printed a letter from Mr. G. M. J. Mackay concerning the utility of helium as a convenient source for the production of high frequency oscillations. In this connection it may be of interest to call attention to some other simple forms of generators.

About fourteen years ago the writer was engaged to conduct some experiments for the late Professor Kristian Birkeland, of the Christiania University who, from observations made on his electric furnaces for the fixation of nitrogen, was led to believe that the arc, as therein used, was partly of an oscillatory nature. Birkeland's idea was to produce high frequency oscillations without the use of hydrogen, by simply keeping the arc in motion by means of a magnetic field, with a view to utilizing the oscillations for wireless telephony.

His idea also proved correct, as high frequency oscillations could easily be produced between two circular, water-cooled copper electrodes in a radial magnetic field. Telephonic messages were also transmitted by these means from the university buildings to Bygdø, a distance of about two miles; but the hissing noises due to the arc made understanding very difficult.

In the device used, the electrodes were arranged horizontally, the upper electrode

resting by its weight against the lower one. On switching on the current, the upper electrode was lifted a fixed distance by an electromagnet carrying the main current. This arrangement served to start the arc automatically whenever it went out, a thing that did not happen very often, however, when the apparatus and current were properly adjusted, the arc sometimes burning for hours without interruption. While the available voltage was 220, the voltage between the electrodes was comparatively low, to the best of my recollection about 50.

The energy of the oscillations was sufficient to permit a continuous spark of more than 1 cm. length to be drawn from the secondary circuit, easily melting the point of a thick iron wire. Moreover, it was found possible to increase this energy considerably by working up to three arcs in series on the above voltage. As a latter arrangement did not adversely affect the stability of the arc there seems to be no limit to the amount of energy that may thus be converted into a high frequency current.

An interesting phenomenon was discovered while working this type of a generator: While the oscillatory arc made the impression of a rotating cluster of fat, white sparks, producing a crackling sound, it would, when the current was properly reduced, completely change its character. The fat, white sparks would gradually disappear, giving way to a pale blue, almost noiseless arc, consuming only a fraction of the initial current. When this condition had been attained no current would flow through the primary oscillation circuit which could be detached without any effect on the arc. The latter was also fairly stable, but at a sufficient reduction of the current, or weakening of the magnetic field, it would go out with a sharp click. This arc strikingly resembled the glow obtained by discharges through moderately rarefied air.

In the course of the experiments, other surrounding media than air were tried, among them water. One day it was found that in using the latter medium it was not necessary

to subject the arc to the action of a magnetic field in order to produce oscillations. In fact, the oscillations obtained by simply immersing two copper rods in water and starting an arc between them were much more powerful than those produced by a single arc in air, and the stability of the wet arc left nothing to be desired.

This discovery so discouraged Professor Birkeland from pursuing his original line of investigations that the experiments were dropped.

ANDERS BULL

CHICAGO, ILL.,  
October 25, 1920

#### ROMANCING IN SCIENCE

TO THE EDITOR OF SCIENCE: "O tempus! O mores!" To one who has used Professor Cajori's book with some confidence, his reply<sup>1</sup> to Dr. Partridge is disturbing. Dr. Partridge concluded<sup>2</sup> that we do not know exactly what experiment Galileo performed from the leaning tower of Pisa. Professor Cajori in reply offers data that (apparently unintentionally) substantiate Dr. Partridge's statement, but he says that it appears to him *too sweeping*.

In Professor Cajori's "History of Physics" (p. 32) the following detailed account occurs:

The first experiments, which Galileo made while he was a young professor at Pisa, were decidedly dramatic. At that time the doctrine that the rate at which a body falls depends upon its weight was generally accepted as true, merely on the authority of Aristotle. It was even held that the acceleration varies as the weight. Prior to Galileo it did not occur to any one actually to try the experiment. The young professor's tests went contrary to the doctrine held for two thousand years. Allowing for the resistance of the air, he found that all bodies fell at the same rate, and that the distance passed over varied as the square of the time. With all the enthusiasm, courage and imprudence of youth, the experimenter proclaimed that Aristotle, at that time believed by nearly every one to be verbally inspired, was wrong. Galileo met with opposition, but he decided to give his opponents ocular proof. It seems almost as if

nature had resorted to an extraordinary freak to furnish Galileo at this critical moment in the history of science, with an unusual convenience for his public demonstration. Yonder tower of Pisa had bent over to facilitate experimentation, from its top, on falling bodies. One morning, before the assembled university, he ascended the leaning tower, and allowed a one pound shot and a one hundred pound shot to fall together. The multitude saw the balls start together, fall together and heard them strike the ground together. Some were convinced, others returned to their rooms, consulted Aristotle, and, distrusting the evidence of their senses, declared continued allegiance to his doctrine.

In his reply to Dr. Partridge, Professor Cajori gives "the historical data" and says that from them "it follows that Galileo dropped different weights of a variety of materials and noticed which of them fell faster."

Now, Mr. Editor, from what data does the above quoted thrilling account follow? And from what data and by what processes may other parts of history be reconstructed by scientists? And from what data must it follow in your readers' minds that Dr. Partridge is the scientist guilty of a "declaration" that is "too sweeping"? Recently it cost me many hours of painstaking experimentation to prove that certain improbable statements made in print by a scientist were directly contrary to fact; when the results of the investigation were sent to him, he replied that his had been *merely casual remarks*! Your correspondent happened to see the following in his Montaigne this morning, *Fortis imaginatio generat casum*—there translated, "A strong imagination begetteth chance."

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#### A THRICE TOLD TALE

THE conversation which Professor Campbell describes, in a recent number of SCIENCE, as taking place at the eyepiece of the Lick telescope in September, 1912, prompts me to quote the closing paragraph of my article on the mercury telescope which appeared in the *Scientific American* for March 27, 1909.

<sup>1</sup> SCIENCE, October 29, 1920.

<sup>2</sup> SCIENCE, September 17, 1920.