to become professor of organic chemistry at Hamline University, St. Paul, Minnesota.

Edwin H. Shaw, Jr., has been appointed assistant professor of biochemistry at the University of South Dakota, Vermillion, S. D.

Dr. H. C. Jackson, associate dairy manufacturing specialist of the Bureau of Dairy Industry, at present in charge of the department's experimental work at the Grove City creamery, has accepted appointment as head of the dairy department in the College of Agriculture of the University of Wisconsin.

R. R. McKibbin, assistant professor, soils department, University of Maryland, has been appointed lecturer in the department of chemistry in Macdonald College, Quebec, Canada.

Assistant Professor W. W. Elliott has been promoted to a professorship of mathematics at Duke University.

Professor Zwaardemaker, occupant of the chair of physiology at the University of Utrecht, has resigned his post, having reached the age limit. He will be succeeded by Professor Noyons, of Louvain, Belgium.

DISCUSSION AND CORRESPONDENCE

A COMMUNICATION ON THE MAGNETO-OPTICAL EFFECT AND A CORRECTION

This article concerns the Magneto-Optical Effect, described by me in Science (N. S. Vol. LIII, No. 1382, pp. 565 to 569, June 24, 1921) and *Nature*, June 23, 1921, which was at that time a novel discovery or observation. The description was later followed by a statement of "Further Investigations," (Science, N. S. Vol. LIV, No. 1387, pages 84–85, July 29, 1921).

In the first place, I desire to make a correction in the latter communication, where it is stated that the "flickering observed appears to keep time with the *cycles* and not with the *alternations of current*." This is an error, as it was found later that in reality the described fluctuations do indeed follow the alternations, the mistake being due to misinformation as to the cyclic rate.

It may be desirable here to describe briefly the original phenomena, adding comments which relate to more recently observed facts. A magnetic field produced by a direct current, permanent magnet, or by interruptions or alternations of current is rendered visible even when very weak, by a light smoke from an iron arc. Such fume or smoke is effective for the purpose even when so thin or diffused as to be scarcely noticeable in the air. Such smoke, too, diffused in the space where a field exists, when illuminated from above by sunlight or an artificial source, and viewed in a direction across the light beam, and more or less normal to the direction of the lines of force of the field apparently becomes luminous. In reality it becomes a far better reflector or diffuser in certain directions of the incident light than when the field lines are absent. Viewed along the magnetic lines no increased luminosity is produced even when the field is strong or the illumination strong, or both.

The conditions for its observation seem to be—

1. Illumination transverse (more or less) to the direction of the lines of force of the field.

2. Viewing in a direction more or less transverse to the lines of the field and to the direction of the incident light.

The amount of iron smoke in the air required to produce a very noticeable effect seems to be very small, although density of the smoke increases greatly the contrast between what is visible when current or field is on, and when no magnetic field exists. Indeed, without the presence of the field the smoke from the iron arc may be practically invisible. The illumination from the smoke particles was found to be polarized as if produced by reflection from strings of fine particles, oriented in the direction of the field lines. These particles are exceedingly small, almost beyond ordinary high powers of the microscope, and the striated ferric oxide, which it seems to be can be caught on a microscope slide while the magnetic field is on, and studied under high powers.

The remarkable thing is the small amount of the iron smoke needed to produce the effect and the instantaneous response to very weak fields. Thus, if an open coil or helix without a core of iron be traversed by a fluctuating or slowly alternating current, the flickering may be shown by a detector constituted by holding the open neck of a glass flask over an iron arc for a few moments. Some of the smoke enters the flask, which can then be corked. Such a flask has shown flickering at a distance of twelve feet away from a small coil, through which a low frequency current was sent. And, curiously, when the flask was placed near the coil the flickering was replaced by a steady illumination. When gradually removed from the coil in the direction of its axis, the flickering became more and more pronounced.

This indicates that the orientation or arrangement of the particles to correspond with the field lines, takes place with a weak field, and almost instantaneously in a strong alternating field; in the latter case, being accomplished and maintained throughout the whole wave of current. The zeros seem to be without effect in arresting the appearance, while at a considerable distance away from the same coil, excited as before, the weaker field at such a distance can only orient the particles at or near the maximum of the current waves. This seems to indicate that a certain very low value of the magnetizing force is sufficient for the orientation or alignment of the particles. Retention of vision by the eye may also cover up any very short interruptions in the luminous effect itself.

Use has been made, since the publication of the original descriptions, of the new effect for rendering visible to the eye a rotating field produced by biphase, three phase, or polyphase currents. The effect is unique, and naturally quite interesting. It can be photographed.

If we provide a box with a glass front and back and means for introducing the iron arc smoke, a beam of light sent in from the back with no excitation or magnetic field present, there is no marked result. We may now place on the box a coil lying flat on the top and conveying current. In this case there is clearly displayed a luminous effect; the field of the soil has been depicted. In each case, of course, iron arc smoke has been within the box at each trial. It can be allowed to enter through a hole at the bottom of the box provided therefor.

It is surprising, too, how long a time it takes for the fumes to settle out of the air within the apparatus.

We have constructed a device for rendering visible a rotating field, such as that of a three-phase motor. The structure is, in fact, a three-phase field winding, as in a motor. As the ordinary frequencies would be too high for observation, there is provided a small motor driving at reduced speed a small generator of the three-phase currents needed for the excitation of the field. Usual arrangements are provided for varying the speeds, and thus the cyclic rate or frequency of the currents in three-phase winding. The open field space, as in an alternating current motor with the rotor removed, is arranged with glass ends so that it may receive and retain iron arc smoke. In this way, the revolving field inside the structure becomes distinctly visible as a luminous glow revolving within it.

The direction of revolution may also be instantly changed by the switches provided for reversing two of the phases, and the speed of revolution of the field may be made slow, or so fast that retention of vision results in a continued interior luminosity.

It is probable that with further development such arrangements may be designed as to make use of this magneto-optical phenomenon in the study of distortions in alternating fields by the introduction of closed circuits in the form of rings, plates and various forms of conductors, or even to compare the distortions produced by the material as well as the form of conductors in alternating fields. Perhaps, also, the distortions of field lines produced by revolving or moving conductors even in direct current fields may be exhibited or investigated. My time has not permitted such work, interesting as it may be, to be carried on.

Elihu Thomson

THE EUROPEAN LARCH CANKER IN AMERICA[1]

In April, 1927, members of the Harvard Forest School brought to the senior writer's attention specimens of a trunk of European larch bearing several cankers in the thin smooth bark of the younger parts. The appearance instantly suggested the European larch canker disease and it was quite evident that it was acting as a parasite. Fortunately perfect fruiting bodies were present and the fungus was found to agree in general with the microscopic characters published for *Dasyscypha calycina* (Schum.) Fuckel. Examination of the plantation from which the specimen came showed abundance of cankered trunks and branches. The fungus occurred on dead twigs and branches as well as on living bark of younger parts of the trees. Since that time investigations have been carried on to determine how serious the disease is, and how extensively it is distributed in that vicinity. It has been found attacking European larch (*Larix europaea* DC.), Japanese larch (*L. leptolepis* Gordon), eastern American larch (*L. laricina* (DuRoi) Koch), Douglas fir (*Pseudotsuga taxifolia* (LaMarck) Britton), pitch pine (*Pinus rigida* Miller) and Scotch pine (*P. sylvestris* Linn.) and on four different estates situated in the three towns, Hamilton, Ipswich and Danvers, Massachusetts. In Europe it is reported to attack the additional species which are native or generally introduced here; *Larix occidentalis* Nuttall, *L. sibirica* Ledebour, *Picea excelsa* Link, *P. sitchensis* Carrière, *Pinus nigra austriaca* Asch. & Graeb., *P. cembra* Linnaeus, *P. laricio* Poiret, *P. mugho pumilio* Zenari and *Abies pectinata* DC. The origin of the disease is quite conclusively indicated by the fact that the European and Japanese larches on two of the estates were imported as seedlings from Scotland in 1904 and 1907. Old cankers are located within a foot of the ground on wood which must have been formed when the trees were imported. Some of the diseased Douglas fir is also known to have been imported as seedlings. The amount of infection in European larch runs up to one hundred per cent. of the trees; Japanese larch is relatively resistant, but Douglas fir infection near diseased European larch is about eighty per cent., with

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