Wonders of the Polariscope.

By Fred W. Saxby.

OF all the marvellous phenomena with which Nature abounds, probably none is so fascinating as that wonderful manifestation of energy we call light. The very mystery with which the subject is surrounded serves but to excite our curiosity—the ever-changing beauty of its endless phases charms the eye and delights the mind of all intelligent people. It is proposed to lay before the readers of The Strand Magazine something new and strange, something that light can do that has never before appeared in the public Press. We shall call to our aid the blinding glare of the lime-light, the most searching lens of the microscope, and the mystic prisms of the polarizer; we shall employ the wondrous eye of the sensitive plate in the dark chamber of the camera. It is only by the combined use of all these appliances that we can put upon paper the results of our experiments. There are embodied in the preparation of this brief article the patient work of many great minds and the results of many wonderful researches. Our apparatus has called forth in its construction the highest flights of mathematical skill, the profoundest knowledge of the chemist, the finest handiwork of the mechanician.

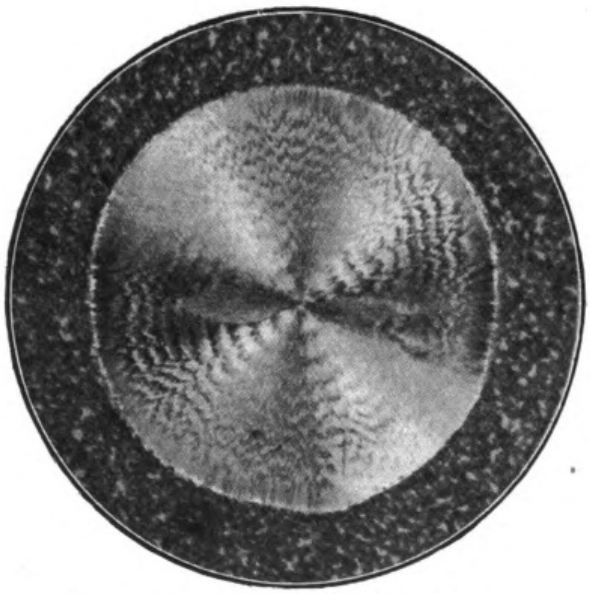

FIG. 1.—CINCHONIDINE CRYSTALLIZES IN DISCS.

Our work is to be among the crystals, not the big ones with which we are familiar in our everyday life, but the microscopic ones, such as we cannot see with our unaided eyes, for they cannot be produced of any appreciable size. We are to see them as the camera sees them, magnified by the most powerful lens that man can make, arrayed in a beauty new and strange by the subtle prisms of the polariscope. The crystals we have to deal with are all extremely thin and perfectly transparent, and it is only by the aid of polarized light that we can hope to get a glimpse of their marvellous structure.

The inquiring reader will naturally ask, "What is polarized light?" Alas! a philosophical answer to that simple question would fill a book larger than the magazine in your hand; but we will endeavour, in a few simple words, to convey to the reader some idea of wherein "polarized" differs from "common" light.

Let us take a beam of common white light—a delicate shaft born on the glowing lime of our oxyhydrogen blowpipe. It launches forth into space a lovely thing, pure and bright. Let us compare it to a bundle of wires, tightly stretched, each free to vibrate in all directions like the wires in a piano. There is music too in the beam, but we hear it only with our eyes. Let us pass it through the polariscope. That instrument consists essentially of two prisms cunningly prepared by trained fingers from a rare transparent mineral. The light beam issues from the first prism, but, lo! its nature is entirely changed: it now resembles a bundle of thin flat tapes of light, packed so close together that we cannot see them, like the leaves in a newly-cut book. The prism has, in fact, flattened our wires into steel tapes, which can only vibrate in one direction or, more correctly, "in one plane." This beam of tapes, which does not visibly differ from its former self, is passed through the microscope and then through a second prism, identical with the first, and finally enters the camera as "polarized" light.

Let us now place on the stage of our microscope, and in the path of this won-

derful beam, a thin glass slide, upon which those minute crystals we are so anxious to see have been deposited. We focus the lens of our microscope upon the glass slide, cross the prisms of our polarizer, and that strange crystal disc, glowing with iridescent light, leaps into being (Fig. 1). The disc is extremely small, the actual area represented in the photograph being less than that of the full-stop at the end of this sentence. How strange the figure, how unlike any crystal we have ever seen before! And the dark shadow of a cross upon it, what is that? If we remove one prism from the polariscope the cross and crystal will vanish into thin air. We had evaporated on our glass slide a solution of "cinchonidine"—a substance closely

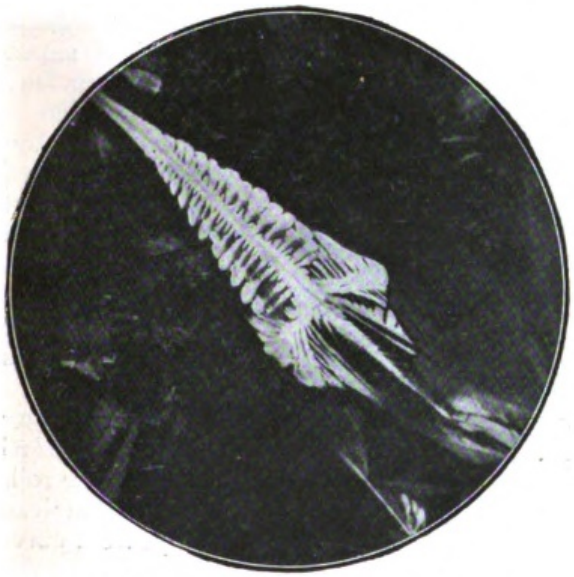

FIG. 2.—HIPPURIC ACID RESEMBLES FERN FRONDS.

resembling quinine, and, like it, obtained from Peruvian bark. Let us examine this curious wheel more closely; surely this is not a crystal? Not one, but tens of thousands—a figure built of tiny crystal needles, all with their points towards the centre, but so close together that they have become one mass. Such is the thin flat disc before you—a speck of matter the unaided eye can never behold! How rich the detail in so small a space!

This lovely frond-like crystal (Fig. 2) is obtained from a substance called hippuric acid. What hidden force has shaped that tiny speck? Think; it is not the one three-hundredth part of an inch in length, and yet what symmetry of form, what delicate grace in the tapering figure—drawn

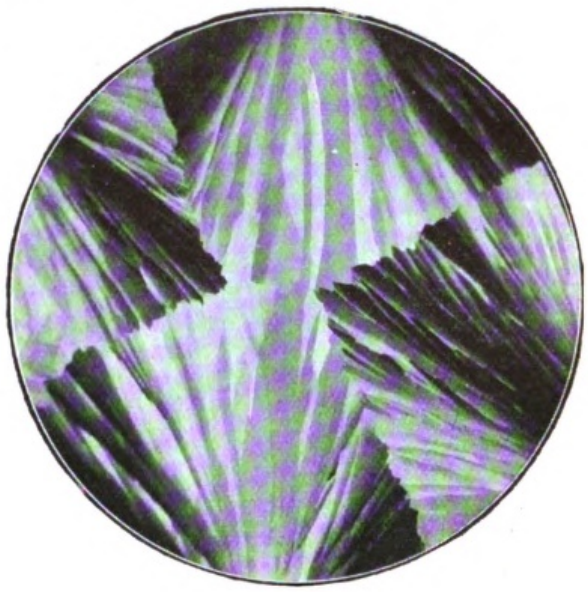

FIG. 3.—SALICIN FORMS VINE LEAVES.

with unerring truth by a pencil of light. Oh, thing of beauty! The more we magnify it the lovelier it would appear. Let man compare his choicest handiwork and sigh—but stay, has he not made the wondrous eye in our microscope? Did he not shape the magic prisms and prepare the cunning plate to see?

These curious crystals (Fig. 3) are obtained from salicin, which is extracted from the bark of willows. They remind us a little of the frosted pattern we sometimes see on tin-ware; the soft gradations of light and shade, so like a crumpled leaf, so unlike what they really are.

Brucine is a substance obtained from false

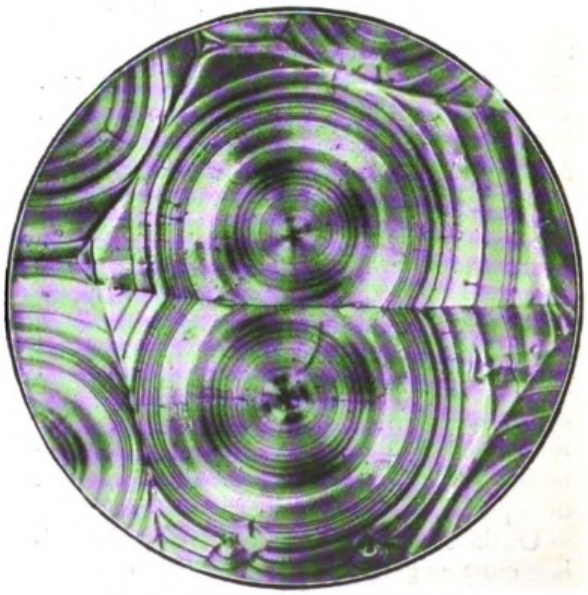

FIG. 4.—BRUCINE CRYSTALLIZES IN RINGS.

FIG. 5.—OXALATE OF CHROMIUM FORMS STARS.

angostura bark, and when crystallized under favourable conditions produces these extraordinary ring-like figures (Fig. 4).

In the centre of each series of rings there is a minute particle of dust, which forms the nucleus around which these ring-crystals gather. Most remarkable of all, the number and character of the rings are the same in both systems - twins they are. This curious likeness will be better seen by comparing the lines as they meet at the point where the discs unite. Those rings which are too far from the centre of the discs to be completed in the figure 8 will be seen to have joined with similar lines from other discs. It is quite evident, then, that similar conditions have produced similar results. There will also be observed a number of tiny specks evenly disposed over the entire mass. Do not forget that the whole of this elaborate drawing is contained within an area about equal to that of a pin's head.

Oxalate of chromium crystallizes in stellate clusters (Fig. 5). How lovely they look gleaming in the darkness with iridescent light, like stars in the midnight sky. No ponderous orbs in the far-away are they, but tiny stars with mystery in their shining, sunk in the dark depths of the great unknown, like the spheres of evening. Ask of their birth, and they will tell you of the waters; they sprang into being in the twinkling of an eye as the gentle heat from the chemist's lamp drove the last vapours away.

A triangular piece of paper with a cross cunningly folded in its substance, you might guess of Fig. 6. No, dear reader, a thin compound crystal of saliginin. The peculiarities of its structure give rise to those soft folds which are all deception. The crystal is perfectly flat, and the strange dark cross is an optical effect that will revolve with our prism like the arms of a spectre windmill. A piece of paper, be it ever so fine, would look like a doormat under the penetrating lens of a microscope; but no power we can bring to bear upon that crystal sheet will show us the inner secrets of its structure.

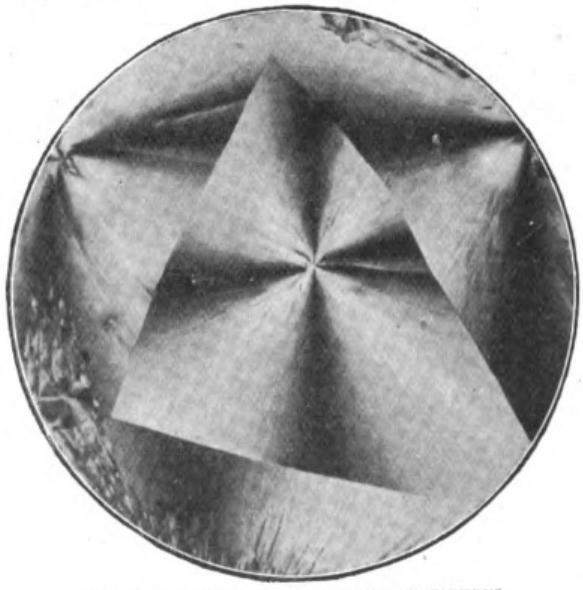

FIG. 6.—SALIGININ MAKES ANGULAR FIGURES.

Whence came these graceful signs and scrolls (Fig. 7) that lead the eye from curve

FIG. 7.—CARBAZOTATE OF CINCHONIDINE FORMS SCROLLS.

to curve, with feathered tufts and leaflets fringed with light? Have the fairies been at play, plucking down from off their wings wherewith to write a message from the gods? Nothing of the kind; they are simply microscopic crystals of carbazotate of cinchonidine—horrid fact. Remove one cunning prism from its place and the fairy hieroglyphics are no more.

This pretty tree (Fig. 8), with winding trunk and branch and leafy bower, is nothing but a frost, a chemical frost. The tree measures one-twentieth of an inch in length, and the chemist tells us in cold blood it is a spray of crystals of nitro-prusside of sodium, for which the symbol is $Na_2Fe_2Cy_5NO + 4HO$. Help! help! where are the fairies?

And now our peep through the polariscope is over: it has shown us something on a new page in the wondrous Book of Nature. But as we close our STRAND a thought recurs to the mind—there is something we have not seen. There must be something that fashioned those crystals into wheels and rings and sprays. What caused them so to be—each of its kind?

The same laws which cause the moon to turn her ever-watchful face to earth have drawn those mystic lines of force round the twins of Brucine, to weave their systems ever into one. The same laws which cause the sun and stars to move in silent grandeur through the sky have been at work grouping the tiny crystals that have formed the subject of this article. Matter, whether it be systems of worlds in space or of crystals under our microscope, is governed by the same laws of Nature. Gravitation, capillary attraction, rotation, and a host of other forces are ever at work on every atom in the universe. By the aid of those giant forces these tiny specks have been formed and arranged with the same perfection, truth, and beauty as the galaxies of night.

FIG. 8.—NITRO-PRUSSIDE OF SODIUM FORMS TREES.