

add laudanum and oil of peppermint. Bottle tight, and shake the bottle before using. Dose for an adult, a tablespoonful night and morning.

Fainting.—At once make patient lie down, with the head quite low. Loosen articles of dress. Let patient have plenty of air, and keep people from crowding round. Apply smelling salts, cautiously, to nose. Sprinkle face with a little cold water smartly. If faint continues long, or feet and hands are cold, apply hot bottles, and when patient can swallow give a teaspoonful of sal volatile in water, or a little spirits in water.

Fits.—This means either apoplexy or epilepsy. Apoplexy is attended with insensibility. The patient falls, generally, but not always, grows purple in the face, and breathes in a snoring manner. There is paralysis of one side, and the mouth is drawn to one side. Place patient in bed, with head raised. If hot, apply cold water to head, and send for doctor.

In epilepsy, patient usually gives a scream, becomes deadly pale, falls on his face, becomes convulsed, and then profoundly insensible. While in this state all that need be done is to loosen articles of dress and keep patient quiet and beyond danger of hurting himself until sensibility returns. It is then a case for medical treatment.

Choking.—Choking arises from food, or fluids, or other substances sticking in the throat or passing into the air passages. In bad choking, where the patient suddenly turns dark in the face, etc., no time is to be lost. Open the mouth and push your forefinger in a determined way over the tongue, right back, and try to hook away or push aside the hinderance. If this does not succeed, you may, by pressing the hinder portion of the tongue, bring on vomiting and so secure relief. A good plan is sometimes tried with children, viz., that of pressing the chest and stomach against something hard, as a table or a chair, then slapping or thumping the back between the shoulder blades. In this way air is driven from the lungs through the windpipe so forcibly as often to expel the obstacle. When the obstruction consists of a coin, as often in the case of children, a good plan is at once to take the child up by the heels and at the same time give it a shake or slap its back. Fish bones can sometimes be got rid of by swallowing a mouthful of bread. If these remedies fail, medical help should at once be called in.

Suffocation by Gases.—Drag the patient as quickly as possible into fresh air, loose clothing, dash cold water on head, face, and upper part of chest. If the breathing has stopped, artificial respiration must be resorted to.

Poisoning.—Send at once for the nearest doctor, telling him all the particulars, so that he may bring what is necessary. Unless the poison is an irritant, such as oil of vitriol or the like, which burns or destroys the stomach, etc., do all you can to make the patient sick. You may give a tablespoonful of mustard in a tumbler of warm water, or the same amount of common salt with warm water. If the patient is drowsy, as from poisoning by narcotics, you must do all you can to keep him awake by dashing cold water on his head and face, walking him about, etc. Do not permit him to sleep. In cases of poisoning by irritantsemetics should not be given, but you should try to save the stomach as much as possible by giving soothing drinks, as milk, etc. Always try to find out what the poison taken has been. You will generally be able to recognize a case of irritant poison, even if the patient cannot tell you, by the stains on the clothes, lips, etc., the burning sensation of the mouth, the terrible suffering of the stomach, the retching, and vomiting of blood, etc. Medical advice must in any case of poison be called in with the utmost haste.

Poisoning by Alcohol, or Drunkenness.—Get the patient under cover as soon as possible. If insensible, rouse him by dashing cold water on the face. Endeavor to make the patient vomit. Rub the surface of the body with warm, dry cloths; wrap the patient in blankets; put hot water bottles to his feet, and do all you can to keep up the heat of body, which is always lowered in the state of intoxication.

Broken Limbs.—The thing to be first done is to keep the limb quite steady till the surgeon comes. This is done by placing on each side of the broken limb whatever may be at hand, such as slips of wood, small pillows, an umbrella, the stock and barrel of a gun, or two walking sticks, or even firmly rolled straw, or pads of cotton wool, and retaining them in their position by one or two handkerchiefs, not tied too tightly. Never raise the patient from the ground until the nature of his injury has been ascertained, or some appliance has been made to prevent the movement of the broken limb. Then raise him, if possible, with the help of several persons, and, as it were, in one solid piece, all moving together, and keeping step in carrying. If a patient has to be carried home, let it be on a shutter, or a table, or a stretcher, on which he can lie flat, instead of being doubled up in a cab, as is often done. It is from neglect of this simple rule that broken bones are often made to protrude through the flesh, simple being thus turned into compound fractures, attended by the risk of the limb being lost.

Restoration from Drowning.—The directions for restoring persons apparently drowned would take up too much space for such a book as this, but they can be got from the Royal Humane Society, and should be in the possession of all persons specially exposed to risk, or likely to deal with such cases.

What to Do when Dress Catches Fire.—The following are the directions given in Dr. Robert's book on ambulance work: "If your own dress, throw yourself at once on the ground, so that the rising flames may not catch the upper part of your clothes nor burn your head and chest; roll about (so putting the flames out by pressure), and at the same time, if possible, wrap yourself up closely in a rug, hearth rug, blanket, table cloth, overcoat, or carpet, so as to smother the fire. Do not get up to call for assistance, but for that purpose crawl to the bell rope or door. If another person's dress, throw the person on fire down at once, wrap him or her up in a rug or something similar, or if there is nothing at hand suitable, use your own coat, rolling the patient about in it, for the purpose of smothering the flames." A woman rendering help in this way must exercise great self-possession, and be careful not to get her own clothes entangled in the flames.

Measles and Scarlet Fever.—When measles or infectious diseases are prevalent in a neighborhood and a child shows symptoms of cold in the head and fever, it

is a reason for immediate carefulness. The diet should be light, cooling, scanty, and the child should be kept indoors. In its ordinary course measles is unaccompanied by danger, but the mildest form may be quickly converted, by want of care, into the most dangerous. The parent should carefully watch the symptoms of change, and if a child complains of piercing headache, intolerance of light, etc., the doctor should be called in at once. It is also most dangerous to resort, without advice, to spirits and such remedies to bring out the rash if it suddenly disappears. Sometimes the disappearance of the rash may be traced to careless exposure to cold. In this case the child should be instantly, and without hesitation, put into a warm bath, care being taken to prevent subsequent cold. Often, however, the cause of the disappearance may be dependent on internal inflammation or too high fever, and medical advice should be at once procured.

Indigestion.—Among the most common causes of indigestion are the undue use of strong or too long infused tea (which taken without food and in excess is destructive), the use of new bread, and eating too fast.

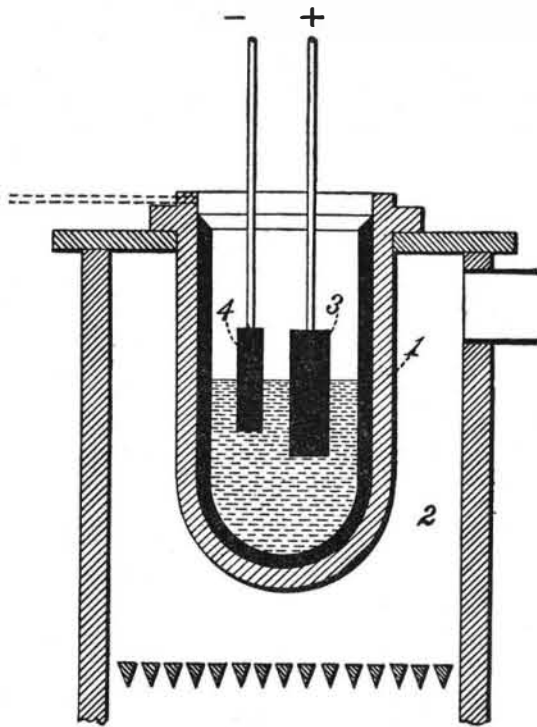
Teeth.—If people wish to preserve their teeth they should brush them, especially at night, gently with a short, soft brush, moved up and down so as to remove remnants of food, etc., lodging between the teeth and so destroying the enamel. This precaution involves little or no expense, and the trouble will be well repaid. When iron tonics or acid mixtures have to be taken, they should always be sucked through a glass tube, which can be got at any chemist's for a penny or two. Doctors often forget to remind patients of this, and, in consequence, the teeth grow prematurely black or loosen and decay.

Recovery from Sickness.—When patients are recovering from measles and scarlet fever, the greatest care must be taken to avoid chills. From the neglect of this precaution after-consequences of the most serious character often occur. Children recovering from these illnesses should be warmly clothed and kept out of cold draughts until they have quite regained strength. It is also the duty of parents who have children suffering from the above diseases to prevent healthy people from coming near them, particularly in the case of scarlet fever, until the stage of peeling of the skin is quite over, when the patient should be well washed with carbolic soap. The bed and bedding should be disinfected as well as the clothing.

Intoxicating Drink.—The abuse of intoxicating drink is the curse of this country. It is the fruitful parent of crime, disease, premature death, and domestic misery in every shape and degree. The judges, with one accord, say that if the people could only be made to abstain from the use of intoxicating drinks, more than half the prisons might be shut up. Men and women who are tempted to sin in this way should abstain entirely. For these there is but one rule of safety—taste not, touch not. Industry, thrift, and strict temperance, these are the simple rules which, by the divine blessing, secure health and lasting happiness.

THE HALL PROCESS FOR MANUFACTURE OF ALUMINUM.

THIS process, that is now stated to be in successful operation in Pittsburg, and by which the price of the metal has been greatly reduced, is described by the inventor,



Charles M. Hall, of Oberlin, Ohio, as follows: I form an electrolyte or bath of the fluorides of calcium, sodium, and aluminum, the fluorides of calcium and sodium being obtained in the form of fluor-spar and cryolite, respectively, and the fluoride of aluminum being obtained by saturating hydrated alumina (Al_2HO_3) with hydrofluoric acid. The compound resulting from the mixture of the above mentioned fluorides, which is represented approximately by the formula $Na_2Al_2F_6 + CaAl_2F_6$, is placed in a suitable vessel, 1, preferably formed of metal and lined with pure carbon, for the purpose of preventing the admixture of any foreign material with the bath or with the aluminum when reduced. The vessel 1 is placed in a furnace, 2, and subjected to sufficient heat to fuse the materials placed therein. Two electrodes, 3 and 4, of any suitable material, preferably carbon, when pure aluminum is desired, and connected to the positive and negative poles of any suitable generator of electricity, preferably a dynamo-electric machine, are placed in the fused bath, or, if desired, the carbon-lined vessel may be employed as the negative electrode, as represented in dotted lines. Alumina in the form of bauxite, anhydrous oxide of aluminum, or any other suitable form of alumina, preferably the pure anhydrous oxide Al_2O_3 artificially prepared, is then placed in the bath, and,

being dissolved thereby, aluminum is reduced by the action of electric current at the negative electrode, and being fused by the heat of the bath sinks down to the bottom of the vessel, the bath being of a less specific gravity than the aluminum. This difference in specific gravity is an important feature of my process, as the superincumbent bath serves to protect the aluminum from oxidation. The oxygen of the alumina is liberated by the action of the electric current at the positive electrode, and, when the latter is formed of carbon, combines therewith and escapes in the form of carbonic oxide (CO) or carbonic acid (CO_2).

As the aluminum is reduced, more alumina is added, so that the bath may be maintained in a saturated condition with the fused alumina. The addition of more alumina than can be dissolved at one time is not detrimental, provided the bath is not chilled, as such excess will sink to the bottom and be taken up by the bath, as required.

The proportions of the materials employed in forming the bath or the electrolyte are approximately as follows: Fluoride of calcium, two hundred and thirty-four parts; cryolite, the double fluoride ($Na_2Al_2F_6$), four hundred and twenty-one parts; and fluoride of aluminum, eight hundred and forty-five parts by weight. These proportions can, however, be widely varied without materially changing the efficiency of the bath. During the reduction of the aluminum the positive electrode, when formed of carbon, is slowly consumed and must be renewed from time to time, but the bath or electrolyte remains unchanged for a long time. In time, however, a partial clogging occurs, which, however, does not render the bath wholly ineffective, but does necessitate an increase in the electro-motive force of the reducing current, the resistance of the bath being increased in proportion to the degree to which the bath becomes clogged, thereby increasing the cost of reduction. In order to entirely prevent any clogging of the bath, I add approximately three or four per cent. (more or less) of calcium chloride to the bath or electrolyte hereinbefore described. As the addition of the calcium chloride prevents, as stated, any clogging or increase of resistance in the bath, it can be used continuously without renewals or any additions, except such as may be needed to replace loss by evaporation, and without increasing the electro-motive force of the reducing current, and, further, the addition of the calcium chloride enables each atom of carbon of the positive electrode to take up two atoms of oxygen, forming carbonic acid (CO_2), thereby reducing the amount of carbon consumed in proportion to the amount of aluminum produced. The calcium chloride being quite volatile is subject to loss faster than the rest of the bath, and must be renewed occasionally on this account.

In reducing aluminum, as above described, I prefer to employ an electric current of about six volts electro-motive force, but the electro-motive force can be varied within large limits.

THE SPECTRUM AND ITS DEVELOPMENT.

By GERALD F. YEO.

EVERY one is familiar with the beautiful play of colors shown when white light is broken up into its component tints.

These are seen when the sun, shining on a passing shower, produces a rainbow, or in the prismatic facets of crystal lusters when we look through them at a luminous object, and are the cause of the brilliant sparkle of the cut jewel as it flashes in the light. All these effects are due to the different colored rays of light being variously turned aside from their straight course on passing from the atmosphere through a denser medium, such as glass, crystal drops of water, or aqueous vapor. This colored image, derived from white light, is called its spectrum.

It is difficult for the uninitiated to realize the position of unique importance given by modern science to this prismatic play of colors. Yet none of the methods of discovery in use nowadays has attracted attention more rapidly or yielded richer fruit in several departments of science than spectral analysis. By it new power has been placed in the hands of scientific workers by which chemical investigations of extraordinary exactitude and delicacy can be accomplished with comparative ease and rapidity.

Not only has this method of analysis been the means recently of discovering several new elementary bodies within the narrow limits of our planet, but it extends our capability of research to the uttermost bounds of the heavens and brings the remotest celestial bodies and mysteries of astronomy within the range of exact analytical investigation. It might, in fact, be said that the spectrum supplied a new sense to the astronomer by means of which his telescope not only enabled him to see the heavenly bodies, but also to test their constitution and study their habits.

Some thirty years ago a chemist could hardly have believed that by an optical method minute quantities of substances could be recognized which escaped detection under the most searching examination by his methods of analysis; and an astronomer would have ridiculed the notion had he been told that in a few years we should have an exact knowledge of the composition of the sun, the most distant stars, and even of the mysterious nebulae. To the ordinary mind even now it seems almost incredible that we can determine, with as great a degree of certainty as appertains to any conclusion in physical science, the chemical composition of the atmosphere surrounding heavenly bodies situated at a distance of millions of millions of miles from our earth.

Although practically the spectrum became a recognized method of analysis only some fifty years since, like all other so-called discoveries which open new roads to knowledge, the growth of spectroscopy has been gradual, and it cannot be said to have been born of the work of any one individual.

When we attempt a historical sketch of its early development as a means of research, we are led back through a long series of additions to our knowledge which extend over many years and consist of new facts and imperfectly understood discoveries recorded by numerous independent observers. These may be regarded as the raw material out of which the science of the spectroscopy was built up and made a perfect method of investigation.

The first fact of importance, which may be regarded

as the foundation stone of all the great modern super-structure, was laid in England by a discovery made by Sir Isaac Newton. In the year 1675 he demonstrated the fact that ordinary white light was in fact a compound of all the colors seen in the rainbow. Each of the series of colored rays, shading from violet through blue, green, and yellow to red, can be made separately visible on a screen by means of a prism. He further showed that the various rays could be reunited by a second prism, so as again to produce on the eye the effect of white light. This splitting up into a series of colored rays is the decomposition of white light.

In his memorable experiments Newton allowed the ray of sunlight to pass through a round hole in a shutter to the prism, and then fall directly upon a screen. By this means an enlarged rounded image of the hole was thrown by each separate tint of color on the screen, and a brilliant diffused spectrum was produced. Owing to the round image projected by each kind of ray overlapping its neighbors, he obtained an uninterrupted series of colors. He therefore failed to observe some dark lines now well known to be characteristic of the pure solar spectrum.

In order to understand the *rationale* of spectroscopic analysis it is absolutely necessary to have some idea of the physical explanation of this decomposition of light.

All the differently colored rays which constitute white light consist of waves in an imponderable medium which physicists call ether. Each color has a different length of wave, those in a red ray being about twice as long as those in a ray of violet light. The vibration of the ether is, therefore, so much more rapid in the case of the violet.

When a beam of light passes obliquely from a medium such as air to a denser one such as water or glass, its direction is changed, so that it proceeds through the denser medium more at right angles to the surface than was the direction of its path on arrival, and *vice versa*, when the ray leaves the denser medium the direction of the beam of light is bent down from the right angle and made more oblique. If the two surfaces are parallel the beam continues on its exit in the same direction as on its entrance, but if the surfaces are not parallel, as in the case of a prism, the direction of the light is permanently changed. This bending or refraction is due to the fact that the rate of traveling of the light is reduced on entering and increased on leaving the denser medium. This retardation of the light does not affect its direction when it comes in a path exactly at right angles to the surface. But when the ray arrives in an oblique direction refraction takes place, because the retardation begins to take effect at one extremity of the approaching wave front before the other has reached the impeding medium, and, consequently, the latter extremity of the wave front moves onward more quickly for a moment than the impeded end, and thus the direction of the wave front is changed.

A rough comprehension of refraction may be gained easily by comparing the beam of light to a column of men marching forward at an even pace in a straight line. If the column comes straight to some obstacle lying at right angles to its line of march, and directly across its front, the direction of its course is not in any way changed, though the rate of progress may be lessened. But if the front line of the column meets the impediment which checks their advance—such as a river to be forded—in an oblique direction, one end of the line is sooner checked than the other. The men as they get into the water have to take shorter steps to keep time with their comrades on land, who, taking the same number of steps, get over more ground, so that while the men in the water advance say ten yards, the longer paces of those on land get over fifteen yards. The direction of the front of the column is thus caused to swerve a little from its former oblique path, and hence its line of march is changed to a course straight across the obstacle. If the banks of the river which is to be forded are parallel, this change of direction produced by entering the impediment is made up for on the other bank. The column on emerging swerves in the other direction, for the men who went in first also come out first, and taking longer paces on their exit, make more rapid progress than their comrades who are still in the water.

If a beam of light be substituted for the column, its change of direction, or refraction, may be similarly followed. When a ray of light enters a prism obliquely it is bent toward the base of the prism, and as it emerges from the second face it is again bent, because the rate of traveling of the ray of light is lessened on entering and increased on leaving the obstacle.

The impediment influencing one part of the wave front before the other causes a change in its direction, just as an oblique impediment changes the line of march of soldiers.

The shorter the length of the waves of a given ray of light, the greater will be the retarding influence of the denser medium. Owing to this fact, the quick waved violet light is more retarded, and, therefore, more bent or refracted than any other colored rays, and, on the other hand, red light is least bent on passing through a prism.

The intermediate colors having wave lengths varying between those of violet and red take up in the spectrum positions corresponding to the length and capacity of their undulations. By using a slit to admit the light to the prism each colored ray yields an image of a thin line, and by the juxtaposition of the images formed by all these separate rays a continuous spectrum of delicately graduated color is produced.

It will be readily understood that if any particular kind of ray, *i. e.*, shade of color, were absent from the source of light used, there would be a break or gap in the sequence of tints, and instead of a brightly colored image of the slit, a dark line or band would be seen in that part of the spectrum.

If, on the contrary, the source of light consists of only one or two kinds of rays, corresponding to one or two colors of the spectrum, then only one or two images of the slit could be seen, and these would not coalesce to form a continuous series of shades of color, but would produce as many bright bands as there were colored rays, separated by colorless or black gaps, corresponding in position with those rays not existing in the source of light used.

From this it may be gathered that it is possible to distinguish three kinds of spectra, which differ in their general characters and mode of production.

First, that of compound white light, in which the series of colors is not interrupted in any way, and the shading passes evenly from the violet to the red, all shades being equally represented. Such a spectrum is characteristic of the light emitted by incandescent solids or liquids, and is called a continuous spectrum.

Secondly, spectra in which a few colored rays here and there are deficient, so as to mark the spectrum with narrow dark lines. These dark lines are really gaps in the spectrum, showing that some ray of special color or wave length has been cut off on its way to the prism. These absorption spectra are seen when some transparent colored body lies in the path of the ray.

Thirdly, spectra obtained from a source of light which emits only one kind or a few kinds of colored rays, which after passing through the prism appear as a few corresponding bright lines, the rest of the spectrum remaining dark.



A PRISM.

This kind of "bright band" spectrum is characteristic of the light given out by bodies in the state of glowing vapor, as seen in flames colored by incandescent gaseous molecules.

EARLY WORKERS.

The first work published on the application of the prism to special purposes, entitled "On the Examination of Colored Flames by the Prism," by Thomas Melville, was printed in Edinburgh in 1752. He examined the prismatic colors through a hole in a piece of pasteboard, and with this primitive spectroscopic became familiar with the remarkable phenomenon of the bright bands in the spectra of various flames, and he was much struck by the local bright band of the flame of spirits of wine and sea salt, but did not draw any useful conclusion from these preliminary investigations, and, unfortunately for science, he died two years later, at the early age of twenty-seven.

The first important step toward the accurate analysis of the spectrum was made by Wollaston. He caused light to pass through a narrow crevice in a dark blind on its way to the prism, and he thus discovered certain dark shadings in the spectrum, which fact he communicated to the Royal Society in the year 1802. By narrowing the aperture in the dark blind through which the light entered, only a very narrow pencil of light was admitted, and the separate colored rays were projected from the prism as very thin bands or lines—images of the crevice. Very little overlapping of the colors then occurred, and those parts of the spectrum where the luminous rays were wanted were indicated by dark shadows, over which the neighboring colors did not spread. He described five dark lines limiting the chief colors of the spectrum, and two finer ones.

He also examined the spectrum of a candle, which, he says, "instead of appearing as a series of lights continuous, may be seen divided into 've images at a distance from each other."

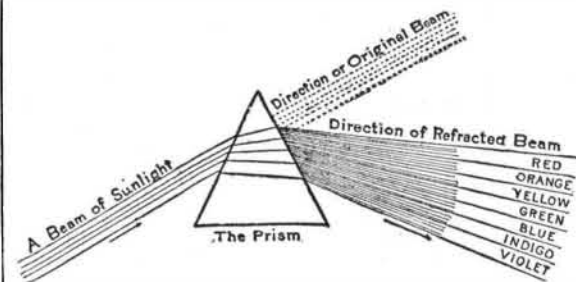
The electric light he found also gave a different spectrum, but he adds: "It is needless, however, to describe minutely appearances which vary with the brightness of the light, and which I cannot undertake to explain."

In 1814 a German optician named Joseph Fraunhofer, while determining the refractive and dispersive power of different kinds of glass, with a view to making achromatic lenses, independently discovered these dark lines in the solar spectrum. He employed the telescope of a theodolite to analyze and measure the position of the lines, and so he saw them to be sharply defined dark lines.

In 1817 he published in Munich a systematic map showing no less than 578 of these lines. Although he did not use any lens to collect the rays, but caused them to pass through the prism from a slit in a window blind at a distance of about twenty-five feet from his observing telescope, the accuracy of his work has never been found at fault, and in recognition of it the solar lines are universally known by his name. He showed that they varied much in distinctness, some being thick and well marked, while others were excessively fine. He noted the coincidence of the dark line, D, in the solar spectrum with the bright yellow lines given in the spectra of many kinds of flame.

He measured their distance from each other, and their exact position in the spectrum, and showed that it was absolutely invariable in all sunlight, whether direct or reflected from the moon or planets. On the other hand, he found, by using a cylindrical lens to lengthen the luminous point to a line, that the light of the fixed stars gave different dark lines of equal prominence, thus he thought proving these stars to be self-luminous. He also observed the difference between the light of a candle and of the electric spark. From the variety in the lines seen when different sources of illumination were used, he concluded that they did not originate in his instrument or in the earth's atmosphere.

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Fraunhofer failed to recognize the full significance of the lines in the solar spectrum, although he went so far as to attribute them to some absorptive power exerted by the sun and stars.

The next step was taken in 1822 by Sir J. Herschel. When making experiments upon the color of flames he examined their spectra and found them more distinctive than the colors of the flames as seen by the eye, because in the spectrum the specific color of the material appeared as a characteristic bright band, while in the flame it was mastered by other shades. He shortly described the bright bands of the spectra he observed in the flames of strontium, copper, and potash chlorides, copper nitrate, and boracic acid. In a subsequent paper published in 1827, he said that "this method in many cases afforded a ready and neat way of detecting extremely minute quantities of many substances, which, when examined by prismatic analysis, are found to possess the peculiar rays in excess which characterize the tints of flames colored by them, so that there can be no doubt that these tints arise from the molecules of the coloring matter reduced to vapor, and in a state of violent ignition."

In 1822, the same year as Herschel's observation, Sir David Brewster turned his attention to the spectroscopic, and examined the influence exerted by several vegetable juices and other colored substances on the spectrum, having, as he afterward said, as his "principal object the discovery of a general principle of chemical analysis, in which simple and compound bodies might be characterized by their action on different parts of the spectrum." He not only found that colored solutions altered the solar spectrum, but also that colored gases cut off some rays, and thus added to the number of lines in the solar spectrum, indicating the rays deficient in its light.

The next attempt to make use of the spectroscopic as a method of chemical analysis was made by a distinguished worker at photography named Fox-Talbot. By a paper published in 1826 he added much to the investigations of Herschel and Brewster, and no doubt firmly laid the foundation of chemical analysis by means of spectroscopic observation. In one passage he says: "A glance at the prismatic spectrum of a flame may show it to contain substances which it would otherwise require a laborious chemical analysis to detect." The common yellow flame and striking bright bands now known to be characteristic of sodium he considered must depend on the presence of some special element, in spite of its almost universal occurrence, and its discovery considerably exercised his mind, but he came to no definite determination on the subject. He says, "The yellow rays may indicate the presence of soda, but they nevertheless frequently appear where no soda can be supposed to be present." He thus suspected that it depended on the presence of sodium, but not being able to reconcile this view with its almost universal existence in flames, he thought its prevalence could only be accounted for by attributing it to water. But then he could not account for its absence from the flame of potash salts. On another occasion, when struck with the brilliancy of these bands in red fire, he concluded that they were caused by the sulphur of the mixture burned. Thus Talbot narrowly escaped making the discovery of the sodium spectrum, which later proved a crucial point in the advance of our knowledge of spectroscopy.

Thus before the year 1830 the spectroscopic had been announced as a method of detecting substances in flames by the spectra given by their light, of analyzing solutions by noting their absorptive power on the light passing through them, and had been shown to be influenced by bodies in the gaseous state.

THE INSTRUMENT.

Spectroscopes of which we now familiarly speak are somewhat complex instruments, the gradual outcome of many improvements and additions made concurrently with the advance of the science of spectroscopy.

It may be remembered that the only item really essential for the separation of the rays of white light into a play of colors is a simple prism of glass, crystal, or other transparent body, and in order to be able to see the dark lines or gaps in the solar spectrum it is only necessary that the ray of light be made very narrow to prevent overlapping of the tints.

Such a simple method as a crevice one-twentieth of an inch wide enabled Wollaston to see the chief solar lines. But for more accurate observations, greater separation of the various colored rays is essential.

In order to obtain the requisite degree of dispersion Fraunhofer viewed the beam at the distance of twenty-five feet from the prism, and at the same time he made the very important addition of an achromatic telescope with which he examined the spectrum in detail. He also used a metal plate for his slit, which was 1-40 inch wide, just half the width of that used by Wollaston.

Since the days of Sir David Brewster the slit has been so constructed that its width can be finely adjusted, and thus a pencil of light much narrower than 1-40 inch can be admitted.

This method of spreading out the colors of the spectrum by viewing it from a distance was found very inconvenient, and as the divergent rays coming from the object were refracted by the prism, a confused image was the result.

The greater the divergence of the beam and the more the dispersion in the prism, the greater must be the overlapping, and, therefore, the more indistinct would be the image. This difficulty was, however, overcome by the introduction of a converging lens into the path of the beam coming from the slit, by which means the various rays of light could be made parallel on their way to the prism. Thus a clear image of the slit is seen and a spectrum equally distinct in all its parts, or "pure," is obtained.

This very important step was made by the optician Simms in the year 1830. This achromatic lens, or collimator, is placed next the prism at the end of a tube, at the other end of which is fixed the adjustable slit.

By increasing the dispersion of the parallel rays coming from the lens, sufficient separation of the colors could be obtained without viewing the spectrum from a great distance, and with lenses of suitable magnifying power the image of the slit could be enlarged to make the details of the spectrum easily visible when the spectroscopic is close to the prism.

The most essential parts of the modern spectroscopic may thus be united on a convenient table so as to form a complex instrument, consisting of the following parts:

1. A slit capable of being made exceedingly fine by the approximation of its smooth metal edges.
2. A collimating lens to render the rays on their way from the slit to the prism exactly parallel.
3. A prism, or number of prisms, of as great dispersive power as possible.
4. A telescope for enlarging the minute image of the slit, and thus examining the spectrum.

For many observations a single prism does not disperse the rays enough to give a sufficiently long spectrum—*i. e.*, does not spread out the various tints so as to make the details of fine lines, etc., visible; hence it becomes necessary to use a more dispersive medium or increase the number of prisms. A great number or battery, consisting of four, six, or even fourteen prisms, may be so arranged that the light will pass symmetrically through them, and enormously increase the dispersion.

Instead of using a battery of prisms to obtain extreme dispersion by their power of refraction, the phenomenon known as diffraction may be employed to produce the requisite dispersion of the rays.

Very early in the history of optics (1665) it was noticed that the shadow of an edge of an opaque body was not perfectly sharp, even when illuminated by a point of light, but was partially lighted up at the margin by light which had apparently bent round the edge of the object. The beautiful chromatic effects observed by Scherzer in looking at the sun through a bird's feather are due to this diffraction, and a bright light viewed through the eyelashes or the meshes of a handkerchief will show similar colors, due to the same cause. These phenomena depend upon the interference of the light waves as they pass round the edge of the opaque body. If we bear in mind the fact that light consists of a series of undulations in some way comparable with the waves on water, the circumstances which give rise to interference are not difficult to follow. Just as the waves of the sea, meeting a projecting pier, are often seen to give rise to secondary systems of waves, so the waves of light, meeting an obstacle in their path, produce a similar disturbance in the ether and give rise to secondary waves. These secondary waves merging into the original waves, or with another set of secondary waves, will produce in the ether, as in water, the effect of interference. If two sets of equal waves so come together that the crest of one set coincides with the crest of the other, a wave of double size results. If, however, the crest of one set coincides with the trough of another set, *i. e.*, if their position differ by exactly half a wave length, then the one set annuls the other, and there is no wave motion. Thus, the effect which produces a calm in water gives darkness in ether.

If a narrow slit in the end of a tube be directed to a source of monochromatic light, say red, and examined through a second slit placed at the opposite end of the tube, a bright red image will be seen in the center, due to the original waves that pass straight through. On each side of this central image would be seen a dark space and then another red image, and so on, a series of dark spaces and red images fading in brightness as the distance from the central image became greater. But as red light consists of waves of greater length than the other colors, blue for instance, so the distance from the central image at which extinction and re-enforcement occur will be greater with red than with blue light, so that if the latter were employed, the blue images would be seen closer together. Thus each colored ray will have its own special angular distance at which it will be annulled and again rendered visible. If, on the other hand, compound white light be used, the various colors having different wave lengths will be differently influenced; the calm and the ripple left by the interference occurring at different distances from the central image fill up nearly all of the dark gaps seen with the red light in the exact order of their wave lengths, and thus make a perfect spectrum.

The means of applying this principle to spectroscopy is called a diffraction grating, which may be substituted for the prisms. The grating may be one of two kinds, a transparent or transmission grating, composed of glass, or a reflection grating made of brightly polished speculum metal. Upon these substances extremely fine lines are ruled, by means of a diamond point, so closely together that there are many thousands to an inch. Mr. Chapman constructed one by a machine devised by Prof. Rutherford, of New York, having as many as 17,280 lines to the inch, and Prof. Rowland, of Baltimore, has recently constructed some six inches in width containing 28,876 lines to the inch. These rulings act as obstacles to the light—transmitted or reflected—and generate secondary waves which by their interference produce a spectrum as above described.

The spectrum thus obtained has the advantage of having its different parts equally extended, which is not the case with refraction spectra, because, the violet end of the spectrum obtained by a prism being more refracted than the red end, the violet rays are relatively more spread out, so that the amount of space occupied by these rays is out of proportion to the relative difference of their wave length. This defect, which is termed the "irrationality" of the prismatic spectrum, is quite absent from that obtained by means of the diffraction grating, as the formation of the spectrum has been seen in the latter case to be solely dependent upon the different wave lengths of the respective rays.

Fraunhofer was the first to attempt to calculate the wave lengths of different colored lights by means of the grating, but as he only used fine wire stretched tightly between two parallel screws of fine thread, the results he arrived at were necessarily rough.

In order to determine exactly the position of any line or band in the spectrum, many methods have been employed. One of the simplest plans is to have a third tube, like the collimator, but instead of the slit, it bears at its extremity a fine scale, photographed on a glass slip, the image of which when illuminated is thrown through a lens to make the rays parallel on the surface of the prism next the telescope. The image of the scale is thus reflected through the telescope, and can be observed at the same time as the spectrum. This tube can be made to lie in the same horizontal plane, so that any line in the scale can be made to correspond exactly with a known line in the spectrum, and thus the position of any other part of the spectrum may be accurately determined.

Instead of the scale a fine wire or line of light from a slit may be moved over the spectrum, and by means

of a micrometer screen the movement or distance of any point of the spectrum from any other can be read off.

In other instruments the telescope itself can be moved in the horizontal plane, and thus a fine wire across the ocular can be brought into exact coincidence with any part of the spectrum, and the position may be seen by the amount of motion of the telescope, which can be read off from a suitable scale on the stand.

Owing to the way in which the rays are turned aside from their path in the prism, the collimator and telescope must be placed at an angle one to the other. They must therefore be supported in the same horizontal plane on a massive stand. To overcome this inconvenience and enable the two tubes to be placed in the same line, so-called direct vision spectroscopes have been made. This arrangement was only possible owing to the fact that flint and crown glass differ in their refractive and dispersive powers. The less dispersive crown glass is used to bend back the slightly refractive but much dispersed ray from a flint glass prism, so that the central position of the dispersed ray comes to form a straight line with the incident ray of the collimator. Thus many convenient forms of pocket, miniature, and microspectroscopes are made which are most useful in many branches of science.

A reflecting prism was added outside the slit by Bunsen and Kirchhoff by which a constant spectrum of the sun or other light may be seen immediately below the one under examination, and thus a ready comparison may be made. By using the Fraunhofer lines as standards, the position of the new bands could be found and their coincidence accurately determined.

FLAME SPECTRA.

From the investigations already alluded to it may be gathered that when bodies are in the glowing gaseous state they show a flame with a particular shade of color, which appears in the spectrum as one or more bright bands. Owing to the constancy of their position, it was further supposed that the bands given by each substance were distinctive of it.

In order, then, to use the spectrum as a method of analysis, it became necessary to have the various substances examined in the state of heated vapor, which naturally requires a very variable degree of heat. With some bodies, such as sodium and potassium, etc., the relatively cool flame of burning spirit sufficed; others could be made glow with a mixture of coal gas and air, as used in what is familiarly known as Bunsen's burner, but in the case of the heavier metals a more intense heat was necessary. For others different kinds of blowpipes were used, and some required the great heat of the oxyhydrogen flame, and even this failed in some cases to give the requisite degree of heat. An important step was therefore made in the development of spectral analysis by the introduction of the electric spark for the purpose of volatilizing metals. Although used by Wollaston and Fraunhofer, its value as an aid in spectral analysis was not known for many years after their time.

In the year 1835 Wheatstone gave the results of an investigation in which, when examining the spectrum of various kinds of electric sparks, he found that the position of the bands varied with the kind of metal used for the electrodes. The lines characteristic of the metal becoming manifest in the spectrum, he concluded the spark was a volatilization of the metal, and not a combustion of the matter of the poles. He writes: "These differences are so obvious that one metal may easily be distinguished from another by the appearance of the spark, and we have here a mode of discriminating metallic bodies more readily than that of chemical examination, which may hereafter be employed for useful purposes." In the plate accompanying his work the characteristic lines of the sparks of many metals and of the sodium flame are clearly indicated.

The first map showing the bright bands characteristic of different substances in the glowing state was made in 1845 by the well-known chemist, W. A. Miller. He examined the flames of the alkaline earths, and made some interesting additions to the knowledge on the subject; but as flames luminous with other substances were used, the drawings are not sufficiently characteristic to be regarded as distinctive tests.

In 1853, Angstrom, the distinguished Swedish philosopher, who has added so many original facts and so much accurate knowledge to this subject, published a paper on optical researches in which he foreshadowed many of the conclusions which a few years later made a complete change in the science of spectroscopy. He showed that "the spectrum of electric sparks must really be regarded as consisting of two distinct spectra; one of which belongs to the gas through which the spark passes, and the other to the incandescent metallic particles from the electrodes."

He stated his belief in the distinctiveness of the bright bands seen in the spectrum of flames, which he considered characteristic of the chemical substances in the flames.

In 1857, Swan, while examining the spectrum of the flames of the hydrocarbons, came to the conclusion that the yellow light so difficult to exclude from flames and the bright bands so constant in the orange part of their spectrum depended on the presence of sodium salts, which existed in everything examined. He says: "When, indeed, we consider the almost universal diffusion of the salts of sodium and the remarkable energy with which they produce yellow light, it seems highly probable that the yellow line which appears in the spectra of almost all flames is in every case due to the presence of minute quantities of sodium."

Swan further made a valuable contribution toward the solution of the question as to whether the bright lines of a glowing gas are solely dependent on its chemical constituents, and he showed that by raising the temperature with the blowpipe lines could be made to appear which were not distinguishable in the ordinary flames of the substance.

It was soon recognized that the great value of this mode of detecting chemical elements, etc., lay in its great delicacy, quantities of matter which were unrecognized by ordinary chemical analysis being easily detected by the spectrum of its flame. Thus one millionth of a grain of lithium, strontium, and calcium can be recognized easily in the colorless flame of coal gas mixed with air, while the delicacy with sodium is so great that even the amount in the dust of the atmosphere can be seen to give a yellow color to this flame and a distinct and very characteristic band.

The foregoing observers may be said to have laid the foundation of the new mode of chemical analysis, but it remained for subsequent observers to perfect the methods, and by its means make more important discoveries.

In spite of the admirable generalization of Angstrom the various discoveries in connection with this subject remained as isolated facts until the work of Bunsen and Kirchhoff made a new epoch in the applications of spectral analysis. Not only did they place beyond doubt the special spectra of the alkaline earths, but they also greatly improved the methods previously in use, and they introduced a new plan of mapping out the spectra so as to render their differentiation more ready and complete.

Bunsen, while examining the alkalies in a mineral water, found some bright lines which he had never met with before in the spectrum. He evaporated very large quantities of the water and succeeded not only in detecting and separating two new elementary bodies, but also in finding out the properties of several of their compounds. These elements, which he called *rubidium* and *cæsium*, from the peculiar colored bands of their spectra, are so like potassium as to be distinguished with great difficulty from it without the aid of the spectroscopic.

Shortly after (1861) the discovery of rubidium and cæsium by Bunsen, Crookes discovered that a peculiar single pale green band was given by the green flame of a compound he had under examination, and he showed that this band was caused by the presence of a new elementary substance which he called *thallium*. This body, which has since been found in large quantities in certain varieties of iron pyrites, used in making sulphuric acid, possesses some remarkable chemical properties, taking as it does a somewhat anomalous position between the alkalies and the metal lead.

Two years later, 1864, another elementary body was discovered by two professors of the mining school of Freiberg, by means of the two indigo-colored lines seen in its spectrum, whence it received the name *indium*.

In 1876 yet another elementary body was found in France by the use of the spectroscopic. This was the discovery of *gallium* by M. Lecocq Boisbaudran.

The general result of the examination of the various chemical elements in the condition of glowing vapor is that their spectra consist of colored lines or bands with more or less wide intervening spaces. The position of these bands is invariable under all circumstances, a fact which, though implied by many observers, was first vigorously insisted upon by Bunsen and Kirchhoff in 1859. But the number and character of the bands are not so constant, but are found to vary with the temperature and pressure of the vapor. As a rule, the higher the temperature and pressure, the brighter and wider do the bands become. With very high temperature many additional bands may appear. Thus the sodium spectrum gives in the spirit lamp the well known double yellow line, but with higher temperature several other lines appear, and with extremely high temperature associated with high pressure these so increase in breadth and number that the spectrum looks almost continuous. Plucker and Hittorf obtained similar results with the spectra of luminous gases. By varying the pressure of hydrogen, changes take place in the number and character of its bands, and with a maximum pressure the spectrum becomes continuous. It must then be remembered that although spectra with bright bands on a dark ground are characteristic of glowing vapors, under extreme pressure the spectra of bodies in this state may appear to be continuous.

Care must be taken in working with very minute quanta to use the degree of heat best suited for the substance under consideration. Bunsen and Kirchhoff soon found that the delicacy of the spectrum as a test for the presence of the alkalies and alkaline earths increased as the temperature was raised to a certain point. Cappel has shown that for the spectral analysis of alkalies the oxyhydrogen flame gives the most accurate results, but that for metals the electric spark is much more delicate.

ANALYSIS OF LIQUIDS.

So much for the information to be gained from colored flames and by the bright bands, indicative of the presence of substances in the condition of glowing vapor.

Let us now turn to the other kind of spectra in which dark lines or bands are observed, and see how far these absorptive spectra can help in chemical analysis.

The facts concerning the absorption of various rays of light by colored solids and liquids were known before the days of spectral analysis, so it was not surprising that the prism was used to examine colored solutions.

No coloring matter has as yet been found which will absorb or transmit only one kind of colored ray. The colors of transparent solids and liquids, therefore, as seen by white light, are mixed colors, and their absorption varies according to the refrangibility of the light which falls on them and the degree of concentration of the solution.

Brewster was the first to examine colored solutions. He investigated both inorganic, such as cobalt and chromium salts, and organic substances, viz., alkanet roots, cochineal, litmus, chieca, and cudbear.

In order to examine solutions of chemical materials it is only necessary to bring a requisite thickness of the liquid in the path of the beam on its way to the prism. In this way it has been found in a great number of cases that a distinctly selective absorption occurs, that is to say, in addition to the dark lines of the solar spectrum, other dark bands are seen, indicating that corresponding rays have been cut off. These bands can be best seen when white light giving a continuous spectrum is used.

Not only in the inorganic world, but also in organic substances, whose detection offers so much difficulty to the chemist, the spectroscopic recognizes many bodies in the smallest quantities in a complex mixture.

It was shown in 1867 by Askenay that the green coloring matter of plants (chlorophyll) can thus be recognized by one very dark band in the red part of the spectrum, with three fainter bands in the orange, yellow, and green, while the blue shades take a faint red hue. This green solution, therefore, absorbs only certain rays of peculiar wave length or refrangibility, while it transmits all other colors of white light.

In the same way the brilliant red coloring matter of

the blood (oxyhæmoglobin) shows two distinctive dark bands in the yellow and commencement of the green, while the blue and violet ends of the spectrum are nearly extinguished. These bands, which are characteristic of arterial blood, were first pointed out by Hoppe-Seyler in 1863.

In the year 1864 Stokes, of Cambridge, now President of the Royal Society, investigated the spectrum of blood, and found that when its oxygen was removed the double bands were replaced by a single one, which occupied a little more than the space existing between the double band.

When the coloring matter of blood is united with carbolic oxide, as occurs in poisoning from charcoal fumes, it acquires a new and distinctive spectrum, which has been suggested for use in medico-legal purposes.

Sorley has applied the spectroscope to the detection of adulteration, and, devoting himself to articles of commerce, has shown how delicate this means of determining small quantities of many substances in mixture can be made by microspectroscopy.

(To be continued.)

PLANTS USEFUL YET DANGEROUS TO MAN.

By Mrs. N. PIKE.

How true it is that through all plant life our "bane and antidote" lie near together, if we only knew how to seek them. How few there are of even the most dangerous plants that have not some useful properties when brought under the expert eyes and fingers of the chemist. Chemistry and kindred sciences have eliminated tinctures so valuable that many a suffering human being has by their means been snatched from the very jaws of death. On the other hand, to satisfy the worst passions of our nature, hatred, jealousy, and revenge, these same plants have been forced by bad men to yield essences so deadly, when skillfully applied, that mind and body, or both, give way under them, and leave either a wreck with mind unstrung and crippled for life or death in the midst of life occurs.

I will speak first of the thorn apple or *Datura stramonium*. It grows wild in waste places in North America, and a curious fact is that the seeds will remain buried deeply in the earth for years, but if the place is burnt over, the *Datura* springs up through the ashes of the burnt plants. It is a native of Africa and the eastern islands and of Asia. Every one knows the plant with its handsome, bell shaped, white flower and its heavy narcotic scent, and the large seed vessel covered with spines. The whole plant is poisonous, and I know of none more abused to evil purposes than it.

Some East Indian species are said to cause faintness even from inhaling the odor of the flowers. Preparations from the *Datura* are in constant use among many of the tribes of Hindostan to get rid of or punish their enemies, slowly or rapidly, as the case requires. Even a few seeds ground up and put in food cause delirium, often serious illness, if not death. Of course, the action of all poisons is intensified in hot climates. In some cases the plant is bruised and the leaves thrown about where they can be trodden on with the bare feet.

I know of a case where a young, well-to-do Indian from Bombay was courting a colored French Creole girl. Now, as Creoles look down on Indians and call them *les negres*, though many shades lighter than themselves, when Berisammy asked the mother for her girl she was furious, and beat her unmercifully. Soon after the old woman's feet and legs began to swell, and she sent for a doctor, telling him that Berisammy had thrown stramonium round where she had been walking and the poison had entered her bare feet. How true the accusation was I know not, but the woman was laid up for weeks, and every Creole near believed in the poisoning. To quote another instance that came under my own observation. A French-woman in Mauritius believed her husband unfaithful, and as the lower classes there are noted for superstitions of all kinds, fortune telling, charms, etc., she resorted to one of the women whose sole business was preparing potions for diseases of mind and body. The woman gave her applicant a love potion she guaranteed would make her husband faithful for life. It nearly did so, literally, for after taking it he became delirious, and so ill that in her fright she sent for a doctor, who had great difficulty in saving his patient. The woman confessed what she had done, and when the remaining potions were analyzed, the principal ingredient was found to be stramonium.

In very early times this plant was used in pagan countries, and the wild ravings of priests and priestesses were supposed to proceed from infusions of it, and their incoherent sentences the inspirations of the gods. Their communications with the dead and prophecies were the effects of this terrible poison. Many a one has lost his or her life from carelessness in the concoction of the draught, and it was accounted for to the populace that the sibyl was so filled with the divine spirit that the earthly form had to succumb.

Though the poisonous properties are stronger in India, yet they are quite sufficiently so here in America. I knew of a boy who ate some of the seeds, and the whole lower part of the body became paralyzed, and it was with difficulty they saved him from death, but he was a cripple ever after.

There is a brighter side even to the *Datura*, and this much abused plant, with all its venom, if properly manipulated, has healing and health giving properties. I once had a severe fall from a horse, and one knee was so badly bruised I was lame a long time. An old Hottentot woman, seeing how I was suffering, offered to help me. She brought some stramonium leaves and held them over the fire till the stiffness was out of them and they were damp from the juices drawn out by the heat. She then placed them round my knee, and, I must say, the first application drew the flesh and hurt considerably. As fast as they were dry she laid on fresh ones, and by the time she got through I could put my foot to the ground. I never saw a Hottentot who had not a herb remedy for every ill that flesh is heir to.

In China a decoction of the leaves is used in cases of hydrophobia, and the homeopaths use it for convulsions in the same terrible disease, in asthmas, and numerous other complaints, and allopathists as an anodyne and antispasmodic.

Few who have hunted for botanical specimens over

waste places have escaped entirely the sharp stings of the nettles, *Urticadivica* and *Urtica*, caused by the rough leaves being covered with minute tubular hairs, which, when pressed, give out their venom. The parts stung often inflame severely if it is hot weather or the blood out of order. A species growing in India has very serious effects when the plant is accidentally gathered, and one in the island of Timoo goes by the name of daoum setan, or devil's leaf, from the virulence of the poison issuing from the glandular hairs. In former times, when India was under the rule of the savage native chiefs, nettles were constantly used as a terrible means of punishment for both men and women. They were often beaten with them, and even their whole bodies covered with them and exposed to a burning sun to extort money or a confession of imaginary crimes from the wretched victims.

In spite of its stinging properties the common nettle is used in the British Isles and in France in decoctions as a purifier of the blood, and the young shoots are used as greens or spinach. The tincture of *Urtica urens* ought to be in every household as a remedy against stings of wasps, bees, ants, and mosquitoes. It is a sure cure if properly administered for the inflammation consequent on their bites or stings. When collecting marine plants and shells in the shallow waters within the reefs of the islands of the Indian Ocean, I always carried a solution of the tincture with me, as holothuric and other creatures abound covered with hairs like a nettle, but it always allayed the irritation at once. On one occasion my wrist and hand were badly bitten by a swarm of red ants I disturbed, and it seemed as if red hot needles were pricking me, but a lotion of *Urtica* stopped the burning pain.

women are fairly raging, and it takes days to recover, and even then they are sullen and stupid.

Another tree, the cocoanut, one of the blessings to the inhabitants of hot countries, especially to the South Sea Islanders, who look at you with surprise when you tell them it does not grow north, and wonder how you can live without it, as it furnishes them with most of the necessities of their life. Early morning as you pass a tope of cocoanut trees you see several tin cans with a cloth around them hanging under the crown. These were placed there the night before, when Indians scale the tall trees with a thong of leather fastened to each ankle, about a foot apart, and thus climb very rapidly. Soon after daylight the men go round the city with large baskets on their heads filled with *cocoa tendre*, or young cocoanuts before the fruit is formed, and little bottles of the juice drawn from the tree.

This is a pleasant drink on a sultry day, but other bottles are kept to ferment, and the harmless liquor becomes arrack. This makes the men loud and quarrelsome, and often when women join in the drinking it ends in their being severely beaten by their jealous husbands.

I will now speak of two well known plants that are sufficiently dangerous in themselves without the aid of man's villainy to exaggerate the risk. I mean the two species of *Rhus*, the *R. toxicodendron*, or poison ivy, and the *R. venenosa*, or poison sumac. No two plants have been more anathematized than these, and it is scarcely to be wondered at. It is a curious fact that all persons are not equally susceptible to their influence. Even in the same family one or two may be affected and the others enjoy complete immunity.



POISON IVY—RHUS TOXICODENDRON (L.)

To show how valuable even nettles are, I will mention one found in the Neilgherry Hills, in India. Its fiber is said to be worth £200 a ton in England, but the plant has to be boiled to deprive it of its stinging qualities before using.

In the next order to the nettles we find a plant invaluable to man all the world over—namely, the hemp or *Cannabis*. I need not enlarge upon the uses of its fibers for cordage, sailcloth, sacking, or hemp seed for birds, and an oil that serves many purposes in commerce. Man is, however, not satisfied to use it, but must abuse it to gratify that most degrading of passions, the love of stimulants that intoxicate. *Gunjah* is prepared by the Indians from the herb and its peculiar resins, and after the first stimulating effect has passed it affects mind and body. A state of raging excitement follows, till a very pandemonium reigns and horrible murders and crimes frequently ensue from its use. There are strict laws against *gunjah* being sold, but they are constantly evaded.

In Arabia and Turkey, the well known *haschish* is made from hemp, and in Cairo the product goes by the name of *mapouchari*. It is used for intoxication on the west coast of Africa, where it is called *diamba*. One of the species grows in South Africa, and a preparation is made from it by the Hottentots for smoking, called *dacha*. It has much the same effect as the Indian *gunjah*, and it and honey beer are not allowed to be used by the men working for respectable farmers. The latter is even worse than the *dacha*, though it would hardly be supposed that so simple a product as honey could be so perverted. Fresh honey is taken and fermented for some days, and a general invitation goes out to all the neighboring Hottentot farm hands. *Dacha* is passed round, and the first effects of the beer are only exhilarating and produce a noisy chatter, but later on—for the whole tub must be emptied, as it will not keep—the wildest orgies follow. Both men and

Fortunately, hitherto, I am one of the favored, as I often handled the poison ivy before I knew much of the American flora, but always unhurt.

I give a sketch of this plant, that others as ignorant as I was may know it on sight, as it is the commoner of the two, and may be seen climbing over post and rail fences or creeping along the ground the country over.

Many people cannot even approach the *Rhus* in hot weather, as it appears to exhale a noxious vapor, particularly where it grows out of the sun.

One case in point was that of a friend who was so badly affected by the poison ivy that he was confined to his room some days under a doctor's care. His eyes were closed and the face terribly swollen, yet he says he was not within some feet of the plant while hunting for insects.

I will take a few facts relative to the *Rhus* from one of Colonel Pike's note books, which may be of interest. He says: "A friend and myself were out in the fall of the year gathering plants, when we were attracted by some drupes of pretty berries, which we gathered fearlessly, and they were placed with other things and brought home. In the night I awoke with sharp itches of the hands, face, and other parts of the body. I at once arose, as I knew then I was suffering from *Rhus* poisoning. I had studied the matter, as I was aware I was likely at any time to be affected from constantly working and collecting in the woods. I made a strong solution of hypersulphate of soda with boiling water, and with the liquid as hot as I could bear it sponged all the parts affected. I felt immediate relief, as it in a measure checked the spread of the poison, but it was many days before I completely recovered. My friend was less fortunate, and was laid up for a long time, a sight to behold. I discovered one important fact that should be known to every one. I had often handled the leaves of this tree with impunity before this time, and as a strong alkali was a cure, I came to the con-