resulted in one hour and thirty-eight minutes. In the first case the liver was found to contain 94.5 mgm. of arsenious oxide; in the second case, 137.8 mgm. Thus, judging from the amount in the liver at the end of an hour, certainly but a few minutes would have been required for the absorption of a detectable quantity of arsenic.

Arsenic having been deposited in the liver or elsewhere, gradually diminishes, and if the person should survive, entirely disappears in from two to three weeks. A case bearing directly on this point came under the writer's notice some time ago. An entire family were taken sick, directly after eating, with all the symptoms of arsenic poisoning; all of them recovered except one, a middle-aged man, who died just two weeks after partaking of the poisoned food. An autopsy was made, the internal organs were delivered to the writer for analysis, together with the various articles of food partaken of by the family at the time of their sickness. A portion of the bread (786 gm.) contained 32.7 grains of arsenious oxide, while a piece of cake (166 gm.) was found to contain 55.5 grains of arsenious oxide, thus proving the character of the poison.

Analysis of the internal organs gave the following results, showing that at the time of death elimination was nearly, but not quite, complete:

Stomach (365 gm.)	contained	0.10	mgm.	arsenic (As).
One-third liver (428 gm.)	"	.20	"	"
One kidney (283 gm.)	"	.15	"	"
One-half intestine (487 gm.)	"	.20	"	"
Thigh muscle (389 gm.)	"	.25	"	"
One-half brain (390 gm.)	"	trace	"	"

Concise experiments on animals, carried out quantitatively, are capable of yielding many instructive results in reference to the relative distribution of a poison under different conditions. The writer has recently conducted a series of experiments with antimony,[13] a few of the results of which may be advantageously given, as confirmatory of some of the preceding statements.

(*a*) *Hypodermic Injection of a Solution of Tartar Emetic.*—0.120 gm. of tartar emetic was introduced under the skin (right thigh) of a cat weighing 1,262 gm. The animal died in two hours. Following is the distribution of the poison:

	Total weight. Grams.	Weight of Sb. Milligrams.	Sb. per 100 gm. of tissue. Milligrams.
Liver	52.0	6.35	12.21
Brain	27.5	.60	2.18
Heart and lungs	32	.70	2.18
Kidney	12	.15	1.25
Stomach and intestines	74	.80	1.08
Muscle from back	138	1.25	.90
	335.5	9.85	....

In a second experiment a smaller amount of tartar emetic (0.082 gm.) was injected hypodermatically, and instead of being introduced in a single dose, it was divided into three, and injected separately, several hours apart. As a result, the animal lived twenty-two hours after the first dose. The following results show the distribution of the poison:

	Total weight. Grams.	Weight of Sb. Milligrams.	Sb. per 100 gm. of tissue. Milligrams.
Kidneys	11.5	0.60	5.21
Liver	63	1.50	2.38
Brain	9	.20	2.22
Stomach and intestines	98	2.00	2.04
Heart and lungs	17	.25	1.47
Muscle from back	106	.70	.66
	304.5	5.25	....

The only difference of importance between these two cases is the element of time. As might naturally be expected, therefore, there is a more even distribution of the poison in the second case than in the first. Further, in the second case the kidneys stand first in their content of antimony, the liver contains a proportionally smaller amount—much smaller proportionally than was found in the first case. This is, of course, due to the fact that in the second case the animal had lived long enough to admit of extensive elimination, and, consequently, those parts which had originally contained the most, particularly the liver, had been drawn on to the greatest extent; so that at the time of death the excretory organs, notably the kidneys, were the richest in poison. Quite noticeable in both of these cases is the comparatively large amount of antimony in the brain—which fact would agree with the previous statements regarding absorption by the brain when a readily soluble and diffusible form of poison is used.

(*b*) *Injection of a Solution of Tartar Emetic per Rectum.*—0.24 gm. of tartar emetic, dissolved in a little water, was injected into the rectum of a rabbit, in two doses. Death resulted in about twelve hours. Following was the distribution of the poison:

	Total weight. Grams.	Weight of Sb. Milligrams.	Sb. per 100 gm. of tissue. Milligrams.
Stomach and small intestines	172	8.89	15.30
Brain	9	.40	4.40
Rectum and adjoining intestines	18	.55	3.05
Liver	54	1.60	2.96
Kidneys	13	.25	1.92
Muscle	100	1.10	1.11
Urine	20	.20	1.10
Heart and lungs	17	Trace.	....
	403	12.99	....

Perhaps the most noticeable feature of these results is the comparatively large amount of antimony contained in the stomach and small intestines; a result which, taken in conjunction with other similar ones, would appear to indicate special absorptive action on the part of the epithelial cells of these parts. The amount of antimony in the kidneys, and particularly the amount in the urine, indicates plainly that at the time of death elimination was going on rapidly; but the fact that the percentage content of antimony in the liver was greater than in the kidneys, might perhaps be taken as an indication that absorption was not completed.

(*c*) *Experiment on a Dog with Antimonious Oxide.*—A dog weighing 14.2 kgm. received, with his food, 2.073 gm. of antimonious oxide, during a period of seventeen days, in doses of from 0.032 to 0.125 gm. per day. The dog was then killed by chloroform eighteen hours after the last dose of antimony had been given. The following results show the distribution of the poison:

	Total weight. Grams.	Weight of Sb. Milligrams.	Sb. per 100 gm. of tissue. Milligrams.
Liver	452	23.7	5.24
Lungs	140	1.8	1.28
Muscle (fore-leg)	157	1.2	.76
Brain	79	.4	.50
Muscle (thigh)	200	.9	.45
Kidneys	82	.1	.12
Heart	117	Trace.	....
Blood	440	Trace.	....
	1,667	28.10	....

In this experiment, which may be termed a chronic case of poisoning with an insoluble form of antimony, the relative distribution of the poison is seen to be somewhat different from what it was in the preceding cases. First, the brain contains relatively less antimony than in the preceding; secondly, the liver contains a noticeably large amount of the poison, while the kidneys contain only a trace. This latter result would seem to indicate that elimination was going on quite slowly; but analysis of the twenty-four hours' urine showed that the amount eliminated by the kidneys in an entire day was considerable. Thus on one day, the entire twenty-four hours' urine contained 13.5 mgm. of metallic antimony; on another day, 22.5 mgm.

With copper, Ellenburger and Hofmeister have found, by experiments on sheep,[14] that the liver contains the most copper when small doses have been regularly administered, and, further, that this organ retains the metal with the greatest tenacity, they having found it there forty-one days after the last dose. The pancreas was also found to retain the copper with nearly equal tenacity; the kidneys do not contain so much of the poison. Elimination is mainly by the bile or through the intestine. Deposition of copper in the nerve tissue is quite small, but still smaller in the muscles, though copper is to be found in the muscles after administration of copper salts. Ellenburger and Hofmeister also state that the deposition of copper is proportionally much greater if it is administered in numerous small doses, the cells then having time to absorb it.

With lead, Victor Lehmann[15] has obtained some interesting results. In his experiments the lead was introduced by hypodermic injection in the form of nitrate, the animals used being rabbits. Two of his series of results are given in full.

(*a*) 0.5 gm. of lead nitrate introduced at one dose.

(*b*) 0.01 gm. of lead nitrate introduced daily, until finally a total of 0.21 gm. of the lead salt had been injected.

DISTRIBUTION OF LEAD IN (*a*)

	Weight of the organ. Grams.	Content of lead. Milligram.	Lead per 100 gm. of tissue. Milligrams.
Liver	40	0.250	0.625
Kidneys	13	.625	4.807
Heart	3	.125	4.166
Lungs	6	.125	2.083
Intestine	16	.312	1.953
Muscle	30	.187	.625
Bones	7	.187	2.678
Brain	8	.062	.781
Bile	3	.125	4.166

DISTRIRUTION OF LEAD IN (*b*).

	Weight of the organ. Grams.	Content of lead. Milligram.	Lead per 100 gm. of tissue. Milligrams.
Liver	25	0.062	0.250
Kidneys	4	.125	3.120
Heart	5	.187	3.750
Lungs	2	.062	3.125
Intestine	7	.125	1.785
Muscle	10	.031	.312
Bones	3	.125	4.166
Brain	3	.125	4.166
Bile	2	.125	6.250

Very noticeable in both series is the small content of lead in the liver, an organ which, as a rule, contains the largest amount of absorbed poison. The relatively large amount of lead in the bile naturally suggests that the elimination of the metal takes place mainly through this channel, which would account for the small content of metal in the liver. Further, experiments conducted on rabbits show plainly that more lead is excreted in the fæces than in the urine, the lead in the former doubtless coming from the bile poured into the intestines. Quite noticeable also is the large amount of lead in the bones, which amount probably grows larger the longer the lead has time to act.

Naturally, such systematic work as has been done in studying the relative distribution of poisons has been confined mainly to mineral substances, but it is to be hoped that the time will come when there will be a collection of data embracing all poisons capable of detection by chemical means. When such a time does come, it will doubtless be found that we cannot establish any general laws regarding the relative absorption and distribution of poisons as a class, but rather that each individual poison or group of poisons will show some peculiarity characteristic of itself—which possibility, or rather probability, makes it all the more needful for us to acquire, as speedily as possible, accurate knowledge of the relative absorption and distribution of the individual poisons.

Post-mortem Imbibition of Poisons.—Ante-mortem distribution of poisons is, as we have seen, due to the carrying power of the blood and lymph. Poisons are absorbed, distributed, and temporarily deposited. Poisons may, however, travel through the *dead* body, after circulation has ceased, by a process of imbibition or diffusion, by the same method as that by which salt works its way gradually through a barrel of fresh pork when placed on the upper layers. The rate of imbition of poisons depends in large measure upon the interval elapsing between the death of the body and the introduction of the poison. Arsenic, for example, introduced into the rectum shortly after death, before the tissues have become rigid, travels with a fair degree of rapidity and in time may be found in distinct traces even in the brain and spinal cord, while in the abdominal organs the amount present may be quite large. Where a long interval elapses after death, the poison introduced post mortem travels more slowly, but even in this case it gradually penetrates to remote parts. In view of these facts, it is obvious that in cases of poisoning where a surplus of the poison remains in the gastro-intestinal tract after death, and the body is buried for some time prior to the autopsy, the apparent ante-mortem distribution of the poison is liable to modification by post-mortem imbibition. This is an important fact to be kept in mind in drawing conclusions from the analytical data, especially in cases in which a large surplus of the poison is unabsorbed. With metallic poisons, however, putrefaction may quickly put a stop to post-mortem distribution, since the formation of hydrogen sulphide from the decomposing proteid material is very liable to transform the metallic salts into insoluble sulphides, thereby preventing further migration. *R. H. Chittenden.*

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POKE ROOT AND BERRY.—*Phytolaccæ radix*, and *Phytolaccæ fructus* (U. S. P.), Scoke, Garget. These two drugs are defined respectively as "the dried root" and "the fruit" of *Phytolacca decandra* L. (fam. *Phytolaccaceæ*).

This plant is a very large perennial herb with a thick, fleshy root and bearing cylindrical racemes of dark-purple juicy berries. The root, at the crown, attains a diameter of several inches and divides into two or three large branches. It is brownish-white externally and faintly yellowish-white internally. It bears quite a close general resemblance to horseradish, a fact which has led to numerous fatal poisoning accidents. The stems, when young, are bland and juicy and are used by country people in some localities as a pot-herb. They at length attain a height of 1 to 2, in the Southern States 3 or 4 metres, are at first green, afterward red or purple, branched widely, are smooth and cylindrical and hollow when old, though with thin transverse partitions. The leaves are large, alternate, petioled, ovate or oblong, entire and smooth. The flowers are in terminal racemes, becoming lateral and extra-axillary by the growth of the stem. They are regular and perfect, having five sepals, ten stamens, and a ten-celled ovary. The fruit contains ten thin putamina, enveloped in a purple flesh, and each containing a single seed. The fruit, when fresh, is about 1 cm. ($\frac{2}{5}$ in.) broad.

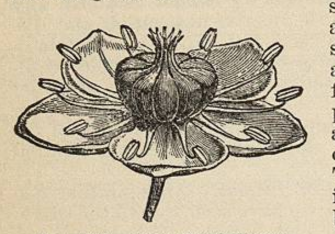

FIG. 3873.—Poke Weed Flower.

For medicinal purposes the root is gathered in the autumn, sliced lengthwise or crosswise, and dried. The berries are gathered when ripe and dried in the sun, in masses.

Description of the Root.—Consisting mostly of transverse or longitudinal slices of sparingly branched, cylindrical, somewhat tapering, usually twisted roots, rarely exceeding 7 cm. (3 in.) in diameter, externally of a rich or yellowish-brown, finely wrinkled (longitudinally or spirally) and thickly annulate with lighter-colored, low ridges; transverse slices exhibiting several concentric rings of interrupted wood wedges, the intervening zones much retracted; longitudinal slices exhibiting the wood bundles as bands, with the intervening medullary tissue greatly retracted; fracture fibrous; internally yellowish-gray; inodorous, the powder highly sternutatory; taste sweetish, afterward highly acrid.

The Fruit.—The dried fruit forms a close and heavy, agglutinated, purple black mass, the stones conspicuous as brightly shining particles, the odor slight, the taste fruity, but peculiar, acidulous and sweetish, somewhat acrid. The structure of an individual fruit is given above.

Poke root contains an actively poisonous, bitter and acrid, amorphous glucoside, which is believed to be saponin, a small amount of the white crystalline alkaloid *phytolaccine*, large amounts of sugar and starch, gum, a little fat, resin, etc. The tannin has been called *phytolaccin*. *Phytolaccic acid* occurs in the root and is, next to the coloring matter, the most important constituent of the fruit.

ACTION AND USE.—All parts of the adult plant are active, and cause in sufficient doses vomiting and purging. It has also some narcotic or stupefying power, and in poisonous doses causes, in addition to the intestinal symptoms, convulsions and coma. Death frequently follows. Its action is slow and protracted. Poke root has been administered as an emetic, but the practice is exceedingly bad. It is also recommended in rheumatism, scrofula, inflamed breasts and testicles, and as a dressing for cancers and indolent ulcers, but is in very little favor in regular practice, probably not nearly so much as its properties warrant. Enough may be absorbed from washes and ointments to produce its constitutional effects. It is said to be useful as a parasiticide in sycosis, tinea capitis, the itch, etc., but there are doubtless many better drugs for this purpose.

The Pharmacopœia, with very poor reason, provides a fluid extract of the fruit but no preparation of the root, of which latter the best form of administration is the fluid extract. The root has been given in 1 gm. (gr. xv.) doses as an emetic, as an alterative in doses of 0.06 to 0.3 gm. (gr. i. to v.), and the dose of the fluid extract should correspond. The fruit and its fluid extract are given in doses five or six times as large. The juice of the fresh fruit is often administered in country practice in doses of 2 to 4 c.c. (fl. ʒ ss.–i.), but its action is very weak indeed.

Henry H. Rusby.

POLAND SPRINGS.—Androscoggin County, Maine. —POST-OFFICE.—South Poland. Springs Hotel.

This resort is located in the town of Poland, twenty-five miles north of Portland and ten miles west of Lewiston, at an elevation of about 800 feet above the sea-level. Poland is reached from Boston by the Boston and Maine Railroad. The spring boils up from a fissure near the crest of a magnificent mound of the oldest rocks at the rate of about eight gallons of water per minute. The bed of the spring is composed of gneiss, scarcely distinguishable from the original granite, this gneiss being, as the geologists inform us, the oldest of the sedimentary rocks. The unvarying temperature of the water throughout the year, as well as its freedom from organic matter, would indicate a very deep origin. The surroundings of the spring have been extensively improved since 1859, in which year, it is said, the water was first described by a physician. The Poland Spring House was erected in 1876, and after various alterations and additions reached its present proportions in 1889. It is situated upon an elevated plateau, and commands a beautiful and diversified view of the surrounding landscape. The analysis of the water made in 1879 by Prof. F. L. Bartlett, State Assayer and Chemist, resulted as follows: One United States gallon contains: Silica, gr. 1.07; calcium carbonate, gr. 1.36; calcium fluoride, a trace; lithia, a trace; organic matter, gr. 0.28; potassium sulphate, gr. 0.18; sodium chloride, gr. 0.47; alumina, a trace; magnesium carbonate, gr. 0.31; iron carbonate, a trace; sodium carbonate, gr. 0.09. Total, 3.76 grains.

This may be classed as a mild alkaline-calcic water, with very slight ferruginous properties. It has long had an extensive reputation in the treatment of rheumatism, gout, and dyspepsia, and in renal and hepatic disorders. It is best known, however, as a table water, for which purpose it has an extensive sale throughout the United States.

James K. Crook.

POLARIMETRY.—Polarimetry is the measurement of the angle of rotation of a ray of polarized light, and instruments adapted to the purpose are termed polarimeters. Polarized light is light which (as explained by the accepted theory) has been changed so that vibrations transverse to the path of propagation have been reduced to a single plane. By this change the rays become much more susceptible to interference and may be used for detecting difference of structure not appreciable to ordinary light. Polarization may be brought about by reflexion or refraction of ordinary light, and also by direct transmission through some substances, such as tourmaline, Iceland spar, and quinine iodosulphate. Of these, Iceland spar is the only practicable material, and all laboratory instruments employ it. The crystal in its natural state, composed of pure calcium carbonate, is rhombohedral and double-refracting, that is, a ray passing into the crystal is split into two rays, both of which are polarized. For the best results in polarimeters the crystal is cut in an oblique direction and the pieces are re-cemented in their original position with Canada balsam. By this means one of the polarized rays is prevented from passing through, while the other is transmitted. A crystal so prepared is called a Nicol's prism. When a ray of light, white or of any color, passes through this prism, it will not be completely transmitted through a second similar prism unless the latter is placed in the same relative position, or 180° of arc from it. At any intermediate position, more or less of the polarized ray will be intercepted, and at a 90° position—technically termed "crossed nicols"—only traces of the light pass. Many substances possess power to affect the ray in such a way that when they are placed between the nicols, these must be turned slightly from the above angles to get the maximum effect of transmission or obstruction, and such an effect is believed to be due to the fact that the intervening body twists the plane of vibration of the polarized ray, and the second nicol has to be twisted to compensate for this. Any substance which possesses this twisting (rotating) power is termed "optically active." The degree of rotation is fairly constant for any given substance under definite conditions, and hence the amount of an optically active substance may be measured by measuring the extent to which the nicols have to be adjusted in order to correct the rotation produced.

In the actual construction of polarimeters many details have to be regarded in order to secure delicacy and accuracy. Many forms have been devised, but only a few are now employed. In all these a beam of light passes through a Nicol's prism, called the "polarizer," then through the substance to be tested, then through another Nicol's prism, called the "analyzer," and then to the eye. As the mind cannot carry a recollection of the exact brightness of a field of light, some comparison is provided as a zero point, and the degree of alteration of the analyzer required to bring the whole field to uniformity is the measure of rotation. Substances differ as to the direction in which the light is rotated. When this rotation is such that the analyzer has to be moved to the right in order to compensate, the substance is termed dextrorotatory and designated +; when the opposite effect is produced the substance is termed lævorotatory and designated −.

The adjustment of the analyzer to restore the zero may be made by the direct rotation of it, and the extent measured in degrees of arc; but in the instruments now usually employed the compensation is made by means of superposed wedges of quartz, which are shifted horizontally to the right or left as required and the amount of shifting indicated on an arbitrary scale termed the "sugar scale." This is graduated and adjusted so that if a solution containing 26 gm. of pure cane sugar dissolved in sufficient water to make a volume of 100 c.c. at 20° C., is examined in the instrument, the rotation will correspond to 100. This scale has been introduced because the principal use of the polarimeter is the determination of the amount of cane sugar in raw sugar and syrups. It enables the analyst to read directly the percentage, but this applies to cane sugar only. For some purposes, monochromatic light must be used, for which a non-luminous gas flame charged with some sodium salt is the best. This gives a pure strong yellow light. The common polarimeters are now constructed to use white light from any ordinary source.

Fig. 3874 shows a form that is now extensively used, the Landolt-Lippich polarimeter, as made by Schmidt & Haensch, of Berlin. *K* is a lens and mirror for illumination and reading the scale. *J H* is the analyzer with the compensating quartz wedges. The details of the optical train are also shown in outline. At the polarizing end, also shown in detail, a large Nicol's prism, which receives and polarizes the light from the lamp, bears in front two small similar prisms, so arranged that the central rays are unaffected by them. By this means is obtained a field uniformly illuminated when the adjustment is at zero; but when any rotating body is introduced, the central segment becomes darker or lighter than the side segments. In a cheaper form of the instrument only one accessory prism is used, and a "double field" instead of "triple field" is obtained. The material to be examined is dissolved in a suitable solvent, clarified if necessary, and a portion placed in a tube of known length closed by glass caps. On now viewing the field, any rotation of the ray will be marked by a contrast in illumination, and to restore the uniformity the quartz wedges must be shifted more or less. A given substance has usually constant rotating power under given conditions, but temperature, density of solution, nature of solvent, and many other factors produce variations.

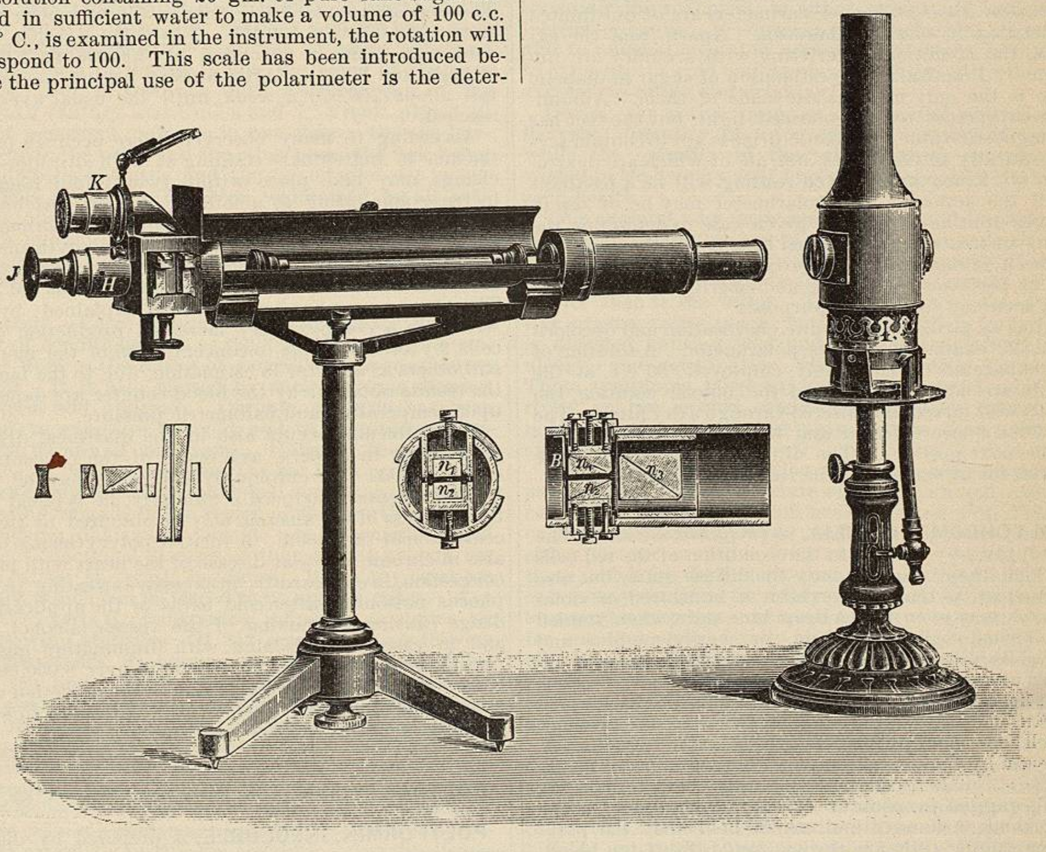

FIG. 3874.—Triple Field Polarimeter with Details of Polarizing and Analyzing Apparatus. (With permission of Eimer & Amend, New York.)

Some bodies have a high rotation when freshly dissolved, but fall off much when allowed to stand or when heated to boiling. This abnormal effect is termed "birotation." Milk sugar shows it to a high degree. In order to make comparisons between different bodies, a factor termed specific rotatory power, indicated by [α], is calculated by the formula $\frac{100a}{cl}$, in which a is the angular deviation observed; c the number of grams of the substance in 100 c.c. of solution; and l the length, in decimetres, of column of liquid examined. As the rotation differs somewhat with light of different colors, the specific rotatory power is now usually given for yellow light corresponding to the D line of the solar spectrum (see *Spectroscope*), and the symbol is written $[\alpha]^D$. In practice certain weights, termed "normal weights," of material are employed. At the International Commission for Uniform Methods of Sugar Analysis held at Paris, 1900, it was agreed that the normal weight "shall be 26 gm. of pure sugar weighed in air with brass weights," and dissolved in 100 true cubic centimetres. Though the principle of the operation of these instruments is simple, yet accurate results are obtained only by much care and experience.

The expense of the standard form of polarimeter has led to efforts to construct cheaper forms for clinical use. The instrument of von Fleischl has met with most favor. It employs white light and is so constructed that two spectra are shown at once with a dark band in each, the two being coincident when there is no rotating body; but one of the bands is displaced when a rotating body is introduced, and the analyzer can be revolved until the coincidence is restored. The instrument is graduated so that the percentage of rotating body can be read off directly. It is constructed for estimation of sugar.

Clinical Applications.—Polarimeters are of but limited application in clinical diagnosis. Apart from the expense, the conditions interfering with accuracy are numerous. Practically, the estimation of sugar in diabetic urine is the only medical use made of them. Albuminous substances rotate polarized light; but the fact has no diagnostic value. Diabetic urine is apt to contain several optically active bodies, not all of which are dextrorotatory; hence the observed reading will be a resultant of all the actions. The polarimeter may be of use in making routine tests in a given case to determine the effects of treatment; but even then it will be necessary to check occasionally by the chemical tests which can now be performed with ease and celerity, and with sufficient accuracy for clinical purposes.

Urine, as a rule, will require clarification and decolorization for examination in the polarimeter. A solution of lead subacetate is commonly employed; 50 c.c. of the sample are added to 5 c.c. of the official solution, the liquids well mixed and filtered through a dry filter. The first 10 c.c. are rejected and the examination is made on the next portions. The dilution must of course be allowed for by increasing the reading ten per cent.

Henry Leffmann.

POLYCHROMATOPHILIA. — (*Polychromasia.*) The term applied by Ehrlich to that condition of the red cells in which they take, not only the diffuse stain, but also the nuclear, so that they exhibit a bluish-red or violet tinge, or may even take a deep blue stain when stained with hæmatoxylin and eosin, or methylene-blue and eosin. By Ehrlich and others this phenomenon is regarded as essentially degenerative, a progressive "coagulation necrosis," whereby the cell loses its affinity for acid stains. They are supported in this view by the presence of such cells shortly after hemorrhage and in starving animals, and by the polychromatophilic character of megaloblasts. Further, cells showing this characteristic are usually ragged in contour or show vacuoles. On the other hand, Askanazy and others hold that the polychromatophilic cells are the *youngest* cells of the blood, and are not degenerating forms. This view is based chiefly upon the fact that a large portion of the red cells of the fœtus are polychromatophilic. According to Sherrington, the brownish color frequently seen in red cells is to be regarded as due to an incomplete oxidation of hæmoglobin. Ewing would regard this as a form of polychromatophilia and would limit the term polychromasia to this diffuse brownish color of the cell, which occurs in anæmias and is also seen in the normal marrow. On the other hand, he would class the bluish-staining granules and areas in red cells, originally designated as polychromatophilia, with Grawitz's *granular degeneration* of red cells. Even though the phenomenon be proved to be identical in significance with the last-named, it would appear best to use the term polychromatophilia in its original application by Ehrlich, and not to transfer it, according to Ewing's suggestion, to an entirely different process.

Aldred Scott Warthin.

POLYCYTHÆMIA.—The increase in number of the red blood cells, due either to an absolute increase in the number of the red cells or to a decrease in the volume of the plasma. An absolute increase in the number of red cells above the normal has not yet been demonstrated to occur. Theoretically, such an increase could be brought about by an increased formation of red cells, or through a longer life of the individual cells. A relative polycythæmia is of frequent occurrence. It occurs in the new-born, and is usually highest before nursing begins, and gradually disappears during the first few weeks. Its cause is doubtless to be found in the temporary concentration of the blood due to various factors. Ewing finds that the polycythæmia bears a rather close relation to the degree of cyanosis exhibited by the expressed drop, and believes that the concentration of blood is principally referable to a state of relative stasis which is established in the peripheral capillaries in the first hours after birth. The average count of red cells in the new-born ranges from 5,368,000 to 6,500,000. Too early ligation of the cord may cause a reduction of 500,000 to 1,000,000 (Hayem and Helot). After nursing begins, the red cells fall about 250,000 a week, until the usual average is reached.

According to many observers there occurs a polycythæmia in individuals residing at high altitudes. The change may take place within twenty-four hours, the increase amounting to a million or more, reaching the limit in two weeks and then remaining permanently high. On return to low altitudes the polycythæmia disappears very rapidly. The percentage of hæmoglobin is less affected, and the volume of the red cells not at all. The phenomenon has been variously explained: by some writers as a compensatory increased production of red cells, by others as due to concentration of the blood, by still others as an error in estimation, due to the fact that the results obtained by the blood-counter are dependent upon temperature and barometric pressure.

Polycythæmia occurs also in the diarrhœal diseases, particularly in cholera, as a result of the concentration of the blood. In chronic dysentery it may be offset by the anæmia produced. Similarly, in typhoid fever the progress of the anæmia may be obscured by the concentration of the blood. A relative polycythæmia occurs also in chronic valvular disease of the heart with passive congestion, in endocarditis, in excessive sweating, in phosphorus poisoning, after cold baths or the application of drugs causing contraction of the vessels (alcohol, etc.), and in cases of poisoning with illuminating gas. In phosphorus poisoning an increase to over 8,000,000 has been observed; it is probably due to the depletion of the blood from vomiting. An increase of 2,000,000 to 3,000,000 may be observed after large doses of salts.

Aldred Scott Warthin.

POLYDACTYLISM.—See *Hands and Fingers, etc.*

POLYFORMIN, INSOLUBLE, is prepared by dissolving resorcin in an aqueous solution of formaldehyde, and adding an excess of ammonia. It is an odorless, tasteless, yellowish-brown, amorphous powder, insoluble in all ordinary solvents and rich in formaldehyde. It is used as an antiseptic.

W. A. Bastedo.

POLYFORMIN, SOLUBLE — di-resorcin-hexa-methylene-tetramine—occurs in white crystals which are very soluble in water or alcohol, but insoluble in ether or oils.

It is decomposed by heating in solution, setting free formaldehyde. Externally, it is employed in parasitic skin diseases, and internally has been used as an antiseptic in the alimentary and urinary tracts and as a diuretic. It is said to appear as formaldehyde in the urine.

W. A. Bastedo.

POLYSOLVOL — Solvin, sodium sulphoricinate—is prepared by acting on castor oil with strong sulphuric acid, adding a solution of sodium chloride, then neutralizing the free acid with soda. It is a thick, clear, light-yellowish oily liquid, insoluble in water, but forming with it a good emulsion. Polysolvol possesses the property of dissolving thirty per cent. of phenol, twenty-five per cent. of menthol, ten per cent. of salicylic acid, and other substances in like proportion.

W. A. Bastedo.

POLYURIA.—(Synonyms: Hyperuresis, Diabetes Insipidus, Diuresis, Essential Polyuria.)

Polyuria means an excessive flow of urine. There are numerous cases in which this occurs temporarily, and is due to dietetic or nervous changes, and a few in which it occurs persistently. The latter are best named *essential polyuria* or *diabetes insipidus.* I shall at the present time describe the latter cases. Instances of persistent or chronic hyperuresis were recognized and described at an early period of medical history, but no attempt was made to classify them. In 1670, however, Thomas Willis discovered the existence of sugar in the urine of some of them, and nearly a century later Sauvages described anew the excretion of sweet urine, as a distinct form of disease, under the name of diabetes anglicus. But it was not until near the end of the eighteenth century that Cullen and P. Frank placed all cases of persistent polyuria in two classes, the one having sugar in the urine and the other none, the first being called diabetes mellitus and the second diabetes insipidus. This distinction has been maintained by all subsequent observers. Diabetes mellitus is now classed with the morbid conditions of assimilation and nutrition. Therefore only the non-saccharine cases, or those of diabetes insipidus, are still thought of as essentially polyurias.

Etiology.—Cases of temporary polyuria are due to a variety of conditions such as the drinking of large quantities of fluid or the eating of excessively large amounts of sugar. It is also caused by such nervous diseases as hysteria and epilepsy. Chronic polyuria has been ascribed to exposure to cold, and to a residence constantly in damp and dark rooms. However, the causative influence of these conditions has not been proved. Injuries affecting the brain and spinal cord, more especially penetrating wounds in the region of the fourth ventricle and medulla oblongata; violent mental emotions and persistent functional diseases of the nervous system are known causes in certain instances. But many cases are on record which can be traced to no special cause. Age evidently exerts a predisposing influence, as shown by the following statistics: Of 242 recorded cases 18 were under five years, 32 between five and ten years, 50 between ten and twenty years, 59 between twenty and thirty years, 42 between thirty and forty years, 20 between forty and fifty years, 13 between fifty and sixty years, and 8 between sixty and seventy years, which is equivalent to 75 per cent. between the ages of five and forty years. Observations in regard to sex show more than twice as many cases in the male as in the female.

There are not a sufficient number of reliable observations on record to justify the conclusion that the disease is hereditary. It seems probable that either a functional or structural disease of the centre in the medulla which controls the blood supply to the kidneys and excretion by them exists in all cases of diabetes insipidus.

Symptoms and Clinical History.—When not the result of direct injuries to the central portions of the nervous system, or of sudden mental emotions, the symptoms of polyuria generally develop slowly and without marked changes, except the gradually increasing quantity of urine which is voided and the correspondingly increased thirst.

When the urine is greatly in excess, the skin appears dry and somewhat shrunken, but much less than in diabetes mellitus. There are some paleness of the features, mental despondency, disturbed sleep, unusual weariness from moderate exercise, excessive appetite for food as well as constant thirst, and frequent eructations and flatulence, with constipation of the bowels. As much as twenty-five to fifty pints of urine may be voided daily. In most cases the specific gravity of the urine is diminished in proportion to the increase of its quantity, varying from 1.001 to 1.008. The fluid is nearly colorless. Its reaction is often neutral or feebly alkaline. Therefore it readily undergoes decomposition. Although the amount of solids in the urine is small, the proportion of urea is often great. A considerable thirst is felt and the mouth and lips rapidly become parched. Appetite is variable. A moderate loss of flesh is the rule, but such patients do not become emaciated. In spite of an appearance of average plumpness these patients lack endurance and ambition. When the disease is not caused by, or associated with, injuries or structural diseases of the brain or spinal cord, it may continue many years, and rarely proves fatal unless from the nature and extent of complications. Some cases have been observed to present great variations in their progress, the quantity of urine sometimes diminishing to the normal, with corresponding improvement in other symptoms, and then increasing again. In some cases exacerbations are traceable to unusual mental or nervous excitement, in others to exposure to cold and damp air, and in still others to excesses in eating and drinking.

During the active progress of essential polyuria the increased quantity of urine consists entirely of water, while the quantity of the other natural constituents voided in the twenty-four hours remains nearly the same as in health.

This explains why the waste of tissues and impairment of health is so much less in this form of disease than in diabetes mellitus, even when the actual quantity of urine discharged in the twenty-four hours is greater in the former than in the latter. The condition of the digestive organs varies much; sometimes food is imperfectly digested, causing acid and gaseous eructations, flatulency, and constipation, alternating with diarrhœa. These symptoms, however, appear to depend more directly on the morbid conditions that have caused the polyuria or have existed as complications, than upon the excessive flow of urine.

Prognosis.—The duration of the disease depends almost entirely upon the nature of the causes and complications. Those cases which are associated with diseases or injuries of the cerebral and spinal centres usually either recover or prove fatal at an early period, while those which are dependent upon chronic functional disorders may continue for many years. R. Willis has left on record a case that continued for fifty years, and Neuffer one that ended fatally in four months. It is generally conceded that permanent recovery from this disease is rare, but it does occur sometimes spontaneously. Complications or intercurrent diseases cause death in much the larger number of instances.

Diagnosis.—The most reliable and characteristic symptoms of diabetes insipidus, or essential polyuria, are persistent daily excretion of quantities of urine above the ordinary maximum of health, or of low specific gravity (between 1.001 and 1.008), and destitute of sugar and albumin; unnatural thirst, increased in direct ratio to the increase in the quantity of urine voided; and a loss of endurance. At first, cases in which polyuria is caused by habitually drinking very large quantities of fluids, may be mistaken, for example, for cases of diabetes insipidus. In the early stage chronic interstitial nephritis may be mistaken for it. This can happen only when albumin does not occur in the urine or occurs only occasionally. In this stage of interstitial nephritis the in-