through certain periodic changes, increasing and decreasing in size, and these changes are accompanied by division of chromosomes in the nucleus, but no cell division takes place. The cleavage of the egg then appears to the process is essentially the same. In the sexual reproduction of all plants that have been examined, it has been found that fertilization is effected by the union of a single germ nucleus of paternal origin with the egg nucleus.

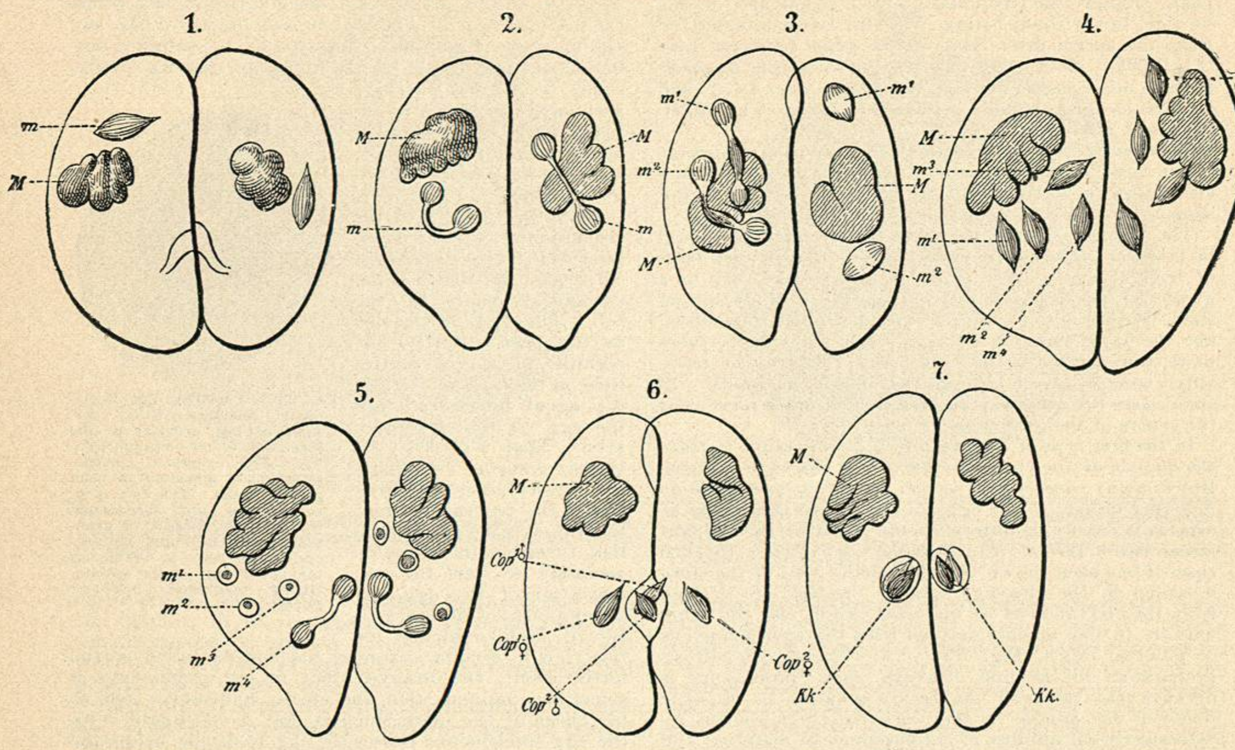

FIG. 2798.—The Conjugation of Infusoria. (From Weismann, after Maupas.) 1, Two infusoria copulating; *M*, meganucleus; *m*, micronucleus; 2-5, successive divisions of micronuclei; 6, fertilization by the migration of one of the persisting micronuclei from each infusorian into the other; 7, union of the interchanged micronuclei.

depend upon the normal behavior of a centrosome closely associated with the nucleus, but this centrosome may be caused to arise *de novo* by appropriate chemical stimuli. It, however, acts much more slowly than the centrosome introduced with the spermatozoon. But the centrosome is not capable of producing cleavage of the cytoplasm unless accompanied by a nucleus. For example, Wilson has found that asters containing centrosomes may be produced by chemical stimulus in enucleated fragments of eggs obtained by shaking unfertilized eggs to pieces. Such asters may multiply by division, but the cytoplasm does not divide. And Boveri has observed that sometimes during cleavage of fertilized eggs all of the chromatin will go to one daughter cell, the other receiving only an aster. In such a case the aster in the enucleated cell will continue to divide, but the cell will not.

Hertwig, Boveri, and others have found that if enucleated fragments of unfertilized eggs be mixed with spermatozoa of the same or closely related species, the spermatozoa will enter the fragments, the nucleus will undergo regular mitotic division, the cytoplasm will divide, and larvæ will be produced that are indistinguishable from normally produced larvæ, except for their smaller size. The sperm nucleus is, then, perfectly equivalent to the egg nucleus and only needs to be supplied with the necessary envelope of cytoplasm in order to undergo the same series of changes; and under certain conditions the normal cycle of life may be inaugurated by either the sperm or the egg nucleus without union with the other, even in species in which normal parthenogenesis is unknown.

The process of fertilization in plants has not been studied so extensively as in animals. But enough has been learned to show that, so far as the nucleus is concerned, This was described for the first time by Strasburger in 1884, and his results have been confirmed by Guignard and a number of other investigators in a variety of plants of various orders. In some plants the paternal gamete is an actively motile spermatozoid, in others it is an immobile cell that reaches the egg cell by a process of growth, as is the case with the pollen tube of the higher plants. But in all essential features the process is the same in both cases.

Although Guignard, in 1891, described with much detail a conjugation of centrosomes in connection with fertilization in the lily, his results have not been confirmed; and most observers have failed to find any evidence of a centrosome in any way connected with either of the conjugating nuclei of plants. This would seem to indicate that the presence of a centrosome is not essential to fertilization. But Strasburger has found that a centrosome appears in Fucus on the side of the cleavage nucleus that is derived from the sperm nucleus, and Wilson approves of his suggestion that in plants "the sperm nucleus may import into the egg either a formed centrosome (probably thus in Fucus) or a certain quantity of 'kinoplasm' which excites the mitotic phenomena in the absence of individualized centrosomes."

The pollen tube of angiosperms contains two sperm nuclei, of which only one unites with the egg nucleus. In 1898 Nawaschin published the interesting discovery that in *Lilium martagon* and *Fritillaria tenella* the other sperm nucleus conjugates with the two "polar nuclei" to form the embryo sac nucleus, the division of which gives rise to the endosperm of the seed. The same phenomenon was described more in detail by Guignard in 1899, and confirmed by Miss Sargent. It immediately occurred to De Vries, and independently to Webber, that

this might explain a phenomenon called *xenia* by Focke (1881). For a long time it has been known that if the pollen of one variety of maize be allowed to fall upon the silk of a different variety, the kernels in the ear may show the characters of the male parent. Until this process of double fertilization was discovered, the embryo was the only part known to have a double origin, and the appearance of the paternal characters in a part of the seed supposed to be purely of maternal origin seemed very mysterious.

From a careful study of the phenomena of xenia in maize, in which the only undoubted cases occur, Webber has reached the conclusion that they are perfectly consistent with the theory of double fertilization, no xenia appearing in characters not connected with the endosperm. But the actual double fertilization has not yet been observed in this plant.

Xenia has been supposed to be a similar phenomenon to *telegony* in animals. But it seems impossible for any such process of double fertilization to occur in animals, and Ewart has found that in the mare "the spermatozoa lodged in the upper dilated part of the oviduct are dead, and in process of disintegrating, eight days after insemination." Moreover, the supposed existence of telegony has been entirely discredited by Ewart on experimental evidence, and by Pearson on evidence from statistics.

In the conjugation of the unicellular animals and plants, we find a process clearly analogous to the fertilization of the higher groups. The two conjugating cells may be similar or diverse in form. In many motile Infusoria (Fig. 2798) two similar individuals come together, exchange nuclei, each one giving off a "male pronucleus," which enters the body of the other and unites with its "female pronucleus," and then the two separate. In other cases there is a motile "microgamete" that forms a permanent union with a sessile "macrogamete," comparable to spermatozoon and egg respectively. In each case the essential feature of the process is a union of two equivalent nuclei, preceded and followed by a complicated series of divisions that we need not discuss here.

Summing up the subject of fertilization, Wilson says ("The Cell," ed. 2, p. 230): "We thus find the essential fact of fertilization and sexual reproduction to be a union of equivalent nuclei; and to this all other processes are tributary." The almost universal occurrence of this process in animals and plants of all grades, from the protozoa to man, indicates that it has some profound significance, but what this is is unknown. According to Weismann, fertilization has for its object the mingling of ancestral germ plasms and the consequent production of variability in the offspring. But Pearson, as the result of statistical investigations, holds that variability is not produced by fertilization. According to Maupas, fertilization has for its object a rejuvenescence of protoplasm, which thus wards off the senescence and "natural death" that must inevitably overtake it if fertilization does not take place; and Minot finds evidence for this view in the results of his investigations of the law of growth (see *Growth*). But when we consider the innumerable generations of domestic plants that have been produced with unimpaired vigor by cuttings, grafts, and other purely asexual methods of reproduction, the existence of any such "natural death" appears to be extremely doubtful. So while our knowledge of the details of fertilization has advanced enormously during the past quarter century, the origin and object of the process remain as mysterious as ever.

Robert Payne Bigelow.

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INCOMPATIBILITY, MEDICINAL.—The word *incompatible*, used in connection with the mutual relations of medicines, is one of very loose application. Thus, in a sweeping way, a medicine is said to be *chemically* "incompatible" with anything that will produce a chemical or physical change in its condition, and *physiologically* "incompatible" with anything that produces the reverse of its so-called physiological effects. Under these definitions, however, it is evident that in many cases so-called "incompatibility" may yet not interfere at all with full medicinal power or purpose. Practically, the subject of medicinal incompatibility deals with those chemical, physical, and physiological mutual relations of medicines that require consideration in the prescription of different medicinal substances in conjunction, and such topic it is that will here be considered.

As regards *chemical* and *physical* reactions there are many which are special, between special medicines. Such must be learned in connection with the individual medicines concerned. But, also, there are certain reactions that affect broad categories of medicines, and which, therefore, admit of general consideration. Such reactions and the practical bearings thereof in prescribing are as follows:

1. *Acids and bases tend directly to combine, to form salts.* This reaction may be utilized, if it be the object of the prescriber to obtain the salt that will result from the bringing together of an acid and base; but if the purpose of the prescription be to retain free acidity or alkalinity, acids and bases must not be conjoined in prescription.

2. *Stronger acids or bases tend to displace, in the case of salts in solution, weaker bodies of their own respective kinds.* Thus, if sodium carbonate in solution be treated with nitric acid, the nitric acid will displace the carbonic to the formation of sodium nitrate in solution and the evolution of carbon-dioxide gas. Strictly speaking, the statement of this reaction is a *circulus in definiendo*, since one acid is known to be "stronger" than another only by

TABLE OF NOTABLE MUTUALLY PRECIPITANT SOLUTIONS.

	Solutions of alkalies.	Carbonic acid and solutions of carbonates.	Sulphuric acid and solutions of sulphates.	Phosphoric acid and solutions of phosphates.	Boric acid and solutions of borates.	Hydrochloric acid and solutions of chlorides.	Hydrobromic acid and solutions of bromides.	Hydriodic acid and solutions of iodides.	Solutions of sulphides.	Tannic acid.	Arsenical solutions.	Albumin.
Alkaloidal solutions (generally)	Prec.	Prec.	......	Prec.	Prec.	......	......	Prec.	......	Prec.	......	......
Metallic solutions (generally)	Prec.	Prec.	......	Prec.	Prec.	......	......	......	Prec.	Prec.	Prec.	Prec.
Lead solutions	Prec.	Prec.	Prec.	Prec.	Prec.	Prec.	Prec.	Prec.	Prec.	Prec.	Prec.	Prec.
Silver solutions	Prec.	Prec.	Prec.	Prec.	Prec.	Prec.	Prec.	Prec.	Prec.	Prec.	Prec.	Prec.
Calcic solutions	Prec.	Prec.	Prec.	Prec.	......	......	......	......	......	......	......	......
Magnesic solutions	Prec.	Prec.	......	Prec.	......	......	......	......	......	......	......	......
Albuminous solutions	......	......	......	......	......	......	......	......	......	Prec.	......	......
Gelatinous solutions	......	......	......	......	......	......	......	......	......	Prec.	......	......

the fact of its supplanting such other acid in saline combination, in solution. The statement, however, is a convenient reminder, to the prescriber, of a set of reactions which are of common occurrence, and whose bearing upon prescribing is as important as it is obvious.

3. *Salts in solution tend to exchange radicals; or acids, or bases, to displace their respective brethren in saline combination, if thereby an insoluble compound will form.* If, as the cant phrase runs, nature "abhors a vacuum," she also *delights in precipitates;* for reactions, determined evidently by the fact that a precipitate will result, are among the commonest occurrences of chemistry. Concerning this reaction it is to be noted that while precipitation may affect potency profoundly in the case of some medicines, in other cases it may make no difference or may be of distinct advantage. Thus in the case of the so-called black and yellow washes of mercury, it is a precipitate which is wanted, and which therefore is intentionally the subject of prescription. Generally, however, the occurrence of a precipitate in a medicinal mixture is objectionable; for, even if medicinal virtue be not affected, the turbidity is unsightly, and, by the settling of the precipitate as the bottle stands, doses drawn, on the one hand, from the full or, on the other, from the nearly empty vial will vary enormously in strength of the precipitated ingredient, unless the bottle be thoroughly shaken at the taking of each dose. The table of *notable* mutually precipitant solutions, taken from the writer's "Manual of Medicinal Technology" (see at the foot of page 853), is convenient for reference. The reactions therein broadly stated as occurring with solutions of salts of the *alkaloids,* and of the *metals,* are true in the *generality* of instances only.

4. *Things in solution precipitate on addition of an excess of a fluid in which they are respectively insoluble.* Here, as in the former instance, precipitation may not affect medicinal potency, but yet is generally to be avoided because of the intrinsic objections to precipitates in medicinal mixtures, as set forth above. The two medicinal solvents most concerned in the present relation are *water* and *alcohol,* and the commonest instances of the reaction in question are as follows: *albuminous, gelatinous, gummy, saccharine,* and certain *saline* bodies dissolve in water but are insoluble in alcohol, and accordingly precipitate on addition of an excess of alcohol to their aqueous solution; while, *vice versa, alcoholic* solutions of *volatile oils, balsams, camphor,* and *resins* precipitate on treatment with excess of water.

5. *Powerfully oxidizing agents may determine explosions on concentrated admixture with readily oxidizable substances.* The exact conditions determining explosions with individual mixtures of this category will vary with the substances concerned, and must accordingly be learned with each medicine. All that is appropriate to state in this place is that the powerful oxidizers used in medicine are *chromic* and strong *nitric* or *nitrohydrochloric acids, potassium chlorate,* and *potassium permanganate;* while the medicinal substances of easy combustibility are *oils, alcohols,* and *ethers* (including in the latter categories *glycerin* and *sugars,* bodies chemically belonging to the alcohols), dry *organic* substances generally, and the elementary bodies, *sulphur* and *phosphorus.*

Physiological incompatibility, as already stated, is alleged between medicines whose respective so-called "physiological" effects are mutually antagonistic. Such antagonisms are individual and peculiar, and are best discussed in connection with the individual medicines concerned. Two points alone are proper subject for mention in this place. The first is that *exact* antagonism in *all directions* of physiological action of drugs is very rare, and the second, that in practical prescribing the fact of an antagonism need not preclude the proper conjunction of two antagonistic medicines in the same mixture. On the contrary, many of the happiest of medicinal combinations are of remedies more or less antagonistic in operation; this either because the antagonism is itself serviceable in mellowing a too intense action of the dominant antagonist, or because the drugs, though antagonistic in some lines, are synergic in others, and so together yield a resultant effect better for certain remedial purposes than the unmodified effect of either medicine used singly. An example of the former instance is the common combination of castor oil and laudanum; and of the latter, the association of atropine with morphine.

Edward Curtis.

INDIAN HEMP. See *Cannabis Indica.*

INDIAN MINERAL SPRINGS. — Kendall County, Texas.

Post-Office.—Boerne. Boarding-houses.

The town of Boerne is located about thirty miles northwest of the city of San Antonio, on the line of the San Antonio and Arransas Pass Railroad. The country has a general elevation of about 1,670 feet above the sea. The general aspect of the country is very pleasing, being quite hilly, even rugged in places. There are many beautiful drives and fine views. The town of Boerne has a population of about 800. It contains a telegraph and express office, very good hotels and boarding-houses. Four trains daily reach the place. From data furnished by the National Climatological Reports it is found that the average number of sunny days in each year is 277, and that invalids can enjoy more or less outdoor life 350 days yearly. The average summer temperature of the place is 85° F.; winter temperature, 62° F. It is said that a cooling southeast breeze from the gulf prevails all the year and greatly tempers the heat of the summer sun, making the evenings and nights cool and pleasant. The location is beginning to attract the attention of Northern visitors, who visit the place in constantly increasing numbers during the winter months. The Indian Mineral Spring is located three miles from Boerne, from which it is reached by stage and private conveyances. The water is said to be efficacious in a variety of debilitated states, besides being a valuable table water. A partial examination was made by Prof. Charles F. Chandler, of New York. It showed the presence of 138.38 grains of solids per United States gallon, consisting principally of calcium, magnesium, and sulphuric acid in the form of sulphates. A more detailed analysis will be required to classify the water properly.

James K. Crook.

INDIAN SPRINGS, BUTTS COUNTY, GEORGIA.—

Post-Office.—Indian Springs. Several hotels in village.

Access.—Viâ Macon and Western Railroad to Forsyth, thence by stage line to spring. This celebrated spring received its name on account of its great reputation as a medicine spring among the Indians. In the treaty of 1821, when all this portion of Georgia was ceded to the whites, a special reservation of one-thousand acres, including Indian Spring, was made by the Creek nation. This, however, was given up to the whites a few years later. In 1823 General McIntosh erected a small hotel, which is still used for its original purpose (Duggan). A village of three hundred or more inhabitants has sprung up in the neighborhood. The following analysis was made by Prof. A. A. Hayes a number of years ago:

One United States gallon contains 648.03 grains of solid matter consisting chiefly of the following ingredients.

Magnesium sulphate.	Calcium sulphate.
Magnesium carbonate.	Potassium sulphate.

Gases { Carbonic acid .... 2.61 cubic inches per gallon.
{ Hydrogen sulphide...... 1.05 " "

The water contains an exceedingly large amount of sulphate of magnesia or Epsom salts. When to this is added the considerable quantity of other sulphates we have a very valuable mineral water. There is sufficient calcium sulphate to exert a useful influence in diseases of the urinary apparatus and also to modify the purgative effects of the sulphate of magnesia. Among the numerous affections in which the water has been found useful may be mentioned dropsical affections when not due to heart disease, rheumatism, and tertiary syphilis.

James K. Crook.

INDIAN SPRINGS, MARTIN COUNTY, INDIANA.—

Post-Office.—Indian Springs. Hotel for 500 guests. Hacks meet all trains during the season. The resort is located eight miles north of Shoals, the county seat of Martin County.

The therapeutic value of the waters of these springs has been known for years, and they were in great repute among the aborigines. The springs were first opened to the public as a health resort in 1814, and they have maintained their reputation ever since. They have their source along the course of Sulphur Creek, which wends its way through the surrounding valley and empties into the Indian Creek one mile distant from the hotel. The surrounding country is hilly and quite picturesque. The following analysis was made by Prof. E. T. Cox, State Geologist:

One United States Gallon Contains:

Solids.	Grains.
Sodium carbonate	3.65
Magnesium carbonate	18.95
Calcium carbonate	33.10
Potassium carbonate	2.40
Sodium sulphate	11.83
Potassium sulphate	2.40
Magnesium sulphate	30.40
Aluminum sulphate	.82
Iron sulphate	20.23
Sodium chloride	39.38
Magnesium chloride	.06
Bromides	Trace.
Iodides	Trace.
Iron oxide	Trace.
Silica	.45
Total	163.67
Gases.	**Cu. in.**
Carbonic acid	9.58
Sulphureted hydrogen	3.33
Oxygen	3.95
Nitrogen	6.45

This water is a powerful chalybeate, also a fairly strong alkaline-saline water.

James K. Crook.

INDIANA MINERAL SPRINGS AND MUD BATHS.— Warren County, Indiana.

Post-Office.—Indiana Mineral Springs. Hotel. This new resort is located four miles from Attica, at the junction of the Wabash and the Chicago and Eastern Illinois railroads. Stages from the springs meet all trains. Although but recently improved, this resort is rapidly coming into popular favor. A first-class hotel, with all modern improvements, has been constructed, and an elegant and commodious bath-house is ready for the requirements of visitors. The naturally picturesque location has already been much beautified by the landscape gardener and architect. The water of the springs is said to be pure and sparkling and pleasant to the palate. A recent qualitative analysis (May, 1893) under the direction of the manufacturing chemists, Messrs. Parke, Davis & Co., Detroit, showed the following ingredients: Total solid residue from one gallon, 20.21 grains, made up of the salts of magnesium, sodium, lithium, calcium, potassium, and silicon. The chemist also reports the presence of sulphuric and hydrochloric acids (probably in combination). There was no organic matter, and the water was highly carbonated. A special feature of the place is a deposit of inky black mud surrounding the springs, and said to be strongly impregnated with the mineral ingredients of the water. This mud is warmed to the proper degree and applied by an attendant to the affected parts —the whole body, if required—in the form of a poultice. About one hour is required for a mud bath, when the patient passes under a shower bath and remains until all traces of the mud are removed. He is then placed in a porcelain-lined tub filled with lithia water for a soaking; then comes a refreshing rubbing by the attendant, and the bath for the day is ended. These baths are said to be very beneficial in cases of obstinate rheumatism, in hemiplegia, and in eczema and gout. The internal use of the water is indicated in renal and bladder affections.

James K. Crook.

INDIANAPOLIS, INDIANA.—The largest city and capital of Indiana is situated near the centre of the State, 195 miles southeast of Chicago. An index of its climate is here given for the sake of reference and comparison.

Climate of Indianapolis, Ind.—Latitude, 39° 46′; Longitude, 86° 10′. Period of Observation, Eleven Years Nine Months.

	January.	March.	May.	August.	November.	Year.
Temperature—						
Average or normal	20.9°	40.3°	64.3°	74.3°	40.7°	53.2°
Average range	15.1	16.3	18.9	18.4	14.0	
Mean of warmest	36.5	49.9	73.8	82.9	49.1	
Mean of coldest	21.4	33.6	54.9	64.5	35.1	
Highest or maximum	69.0	77.0	89.0	101.0	75.0	
Lowest or minimum	−22.0	9.0	31.0	48.0	− 5.0	
Humidity—						
Average relative	73.6%	67.0%	60.3%	68.5%	69.9%	67.7%
Wind—						
Prevailing direction	W.	N. W.	S. E.	S.	N. W.	N. W.
Average hourly velocity in miles	6.4	7.3	5.7	4.5	5.8	5.7
Weather—						
Average number clear days	5.3	6.5	9.5	11.0	6.1	94.8
Average number fair days	10.5	10.6	12.5	14.1	10.2	142.4
Average number clear and fair days	15.8	17.1	22.0	25.1	16.3	237.2

As will be seen, it is a temperate climate, with considerable seasonal extremes and diurnal fluctuations of temperature. The humidity is not high, and the rainfall is moderate. More than a quarter of the days in the year are clear, more than a third fair, and about two-thirds clear and fair.

Such a climate is well-situated for a residence for those in ordinary health. For the delicate or sick, a change might be advised to escape the cold of the winter and the heat of the summer, and in order to obtain purer air than a city affords. As the elevation is low, a change also to a high altitude might be beneficial for various morbid conditions.

Edward O. Otis.

INDIGO, WILD.—Baptisia. *Dyers' Green Weed.* Under these names, the herb, and more particularly the root, of *Baptisia tinctoria* (L.) R. Br. (fam. *Leguminosæ*) has been more or less used in domestic, and to a slight extent in professional medicine. Its common names come from the fact that it has been used as a poor substitute for indigo.

The plant is a large, much-branched perennial herb, very abundant in sandy soil, especially in the borders of woods, throughout the Eastern United States. It is said to contain two glucosides, *baptin* and *baptisin,* and the poisonous alkaloid *baptitoxine,* which is believed to be identical with *cytisine.* According to the dose, the properties vary from stimulant, increasing peristalsis and acting as a laxative, to irritant, producing purging and vomiting. Upon the nerve centres, it is primarily stimulant, secondarily depressant or paralyzant, and causing death by paralysis of respiration. Its use has been chiefly, both systemically and locally, in diphtheria, scarlet fever, and sore throat. The dose of the fluid extract is 1 to 4 c.c. (♏ xv. to lx.).

Henry H. Rusby.

INEBRIETY. See *Insanity: Alcoholic and Drug Intoxication and Habituation.*

INFANCY.—Under the term *infancy* (inability to speak) we include that early period of life which extends from birth to the close of the first dentition. Its first few weeks represent a period of great feebleness during which there exists a liability to special forms of disease consequent upon the great change which takes place in the circulation at birth, and upon the assumption by the several organs of their special work in the economy. To the infant at this period the name of "the new-born" (neonatus) is frequently applied. From the end of the