

directly. Fig. 5048 shows the persistent vessels around the yolk sac.

**HISTOLOGY.**—The wall of the yolk sac of a young rabbit consists of two layers, a lining of simple cylindrical endodermal epithelium and an outer layer of vascular mesoderm (Fig. 5049, from Minot). The latter soon appears divisible into mesenchyma and mesothelium. These with the entoderm make the three layers which are characteristic of later stages. The lining of the human yolk

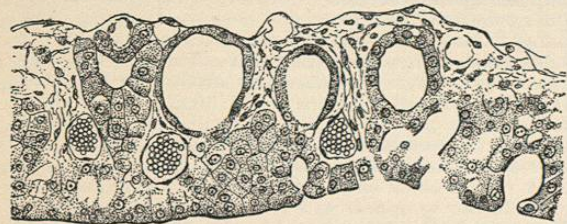


FIG. 5050.—Cross Section of a Human Yolk Sac, from a 9.4 mm. Embryo.  $\times 95$  diameters.

sac is said to be of simple epithelium at first. Subsequently it becomes stratified and thrown into folds, variously interpreted. Kölliker and von Baer have described villi containing blood-vessels, and Paladino has figured irregular elevations in the yolk sacs of dog and rabbit. Tourneux found epithelial depressions extending into the mesoderm, separated from one another by mesodermal papilla. Spee observed slender tubes of entoderm extending across the mesoderm, branching dichotomously, and ending in alveolar enlargements. These he found all over human yolk sacs of six to nine weeks. With Paladino, who regards the mammalian yolk sac as a gland with an internal secretion, and Saxer who finds it a blood-forming organ containing giant cells and blasts, Spee unites in making comparisons with the liver.

The yolk sac of a human embryo 9.4 mm. long, of about four weeks, is without villi. Its proliferated epithelium shows alveolar pockets sometimes resting on the mesothelium and often having no outlets. Between the alveoli there is a small amount of vascular mesoderm, covered with a layer of mesothelium (Fig. 5050).

In a better preserved yolk sac from a 23 mm. embryo of about two months, only an occasional epithelial cyst is found. The dense mesenchyma forms a more definite layer, and the mesothelium is quite distinct (Fig. 5051). The blood-vessels cause elevations on the outer surface which are macroscopic. The endodermal cells are vacuolated, probably containing fat droplets, and are degenerating. They possibly account for some of the stages in blood formation described by Saxer. The resemblance with the liver seems to be remote. At birth the entoderm has wholly disappeared, leaving a connective-tissue

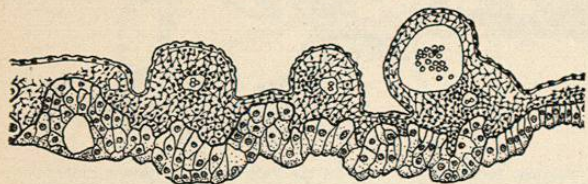


FIG. 5051.—Cross Section of a Human Yolk Sac from a 23 mm. Embryo.  $\times 95$  diameters.

envelope surrounding débris, calcareous granules, fat, and albuminoid bodies (Lönnerberg). Rauber described yolk elements lying free in the mammalian yolk sac. If yolk is present it should be within the endodermal cells; probably Rauber's yolk is a degeneration product.

The yolk stalk in the cord can be distinguished from the allantois by its cylindrical epithelium, generally simple, but sometimes two- or three-layered. The epithelium of the allantois duct is cuboidal.

**PATHOLOGY.**—Meckel's diverticulum may contain concretions, and become inflamed like the vermiform appendix. The intra-abdominal yolk stalk sometimes persists as a band of fibrous tissue, a frequent cause of intestinal obstruction. (Fitz.) Portions of the stalk may form large cysts, and be connected with the intestine or the umbilicus, or lie free in the mesentery. (Roth.) The stalk may remain open from intestine to umbilicus, producing an intestinal fistula. (Neurath and Roth.) Fungiform adenoma at the umbilicus has been attributed to the yolk stalk remains. (Hüttenbrenner.) Cysts which may be numerous along the extra-abdominal yolk stalk (Ahlfeld) and persistent vitelline vessels have no harmful effect upon the foetus. Frederic Thomas Lewis.

**BIBLIOGRAPHY.**

Including the publications cited, except text-books, and those prior to 1850.

Ahlfeld, F.: Ueber die Persistenz der Dottergefäße nebst Bemerkungen über die Anatomie des Dotterstranges. Arch. f. Gynäk., 1877, vol. 11, p. 184.  
 Bonnet, R.: Die Eihäute des Pferdes. Verh. d. Anat. Gesell., 1889, p. 17.  
 Dexter, F.: On the Vitelline Vein of the Cat. Am. Journ. of Anat., 1902, vol. 1, p. 261.  
 Fitz, R. H.: Persistent Omphalo-mesenteric Remains. Am. Journ. of the Med. Sci., 1884, vol. 88, p. 30.  
 Hüttenbrenner, A. von: Ueber den Bau der Nabelschnur. Wiener klin. Wochenschr., 1896, vol. 9, p. 1156.  
 Lönnerberg, I.: Studien über das Nabelbläschen an der Nachgeburt des ausgetragenen Kindes. 1901, Stockholm. Central-Tryckeriet.  
 Neurath, R.: Zur Casuistik des persistirenden Ductus omphalomesentericus. Wiener klin. Wochenschr., 1896, vol. 9, p. 1158.  
 Osborn, H. F.: Observations on the Fetal Membranes of the Opossum and other Marsupials. Quar. Journ. Mic. Sci., 1883, vol. 23, p. 473.  
 Paladino, R.: Contribuzione alle conoscenze sulla struttura e funzione della vescicola ombelicale. L'Arte Medica, 1901, vol. 3, p. 1.  
 Rauber, A.: Ueber secundären Dotter in der Keimblase von Säugthieren. Zool. Anz., 1880, vol. 3, p. 591.  
 Roth, M.: Ueber Missbildungen im Bereich des Ductus omphalomesentericus. Virchow's Archiv, 1881, vol. 86, p. 371.  
 Saxer, F.: Ueber die Entwicklung und den Bau der normalen Lymphdrüsen. Anat. Hefte, 1896, vol. 6, p. 480.  
 Schultze, B. S.: Das Nabelbläschen, ein constantes Gebilde in der Nachgeburt des ausgetragenen Kindes. Leipzig, 1861.  
 Spee, F.: Zur Demonstration über die Entwicklung der Drüsen des menschlichen Dottersacks. Anat. Anz., 1896, vol. 12, p. 76.  
 Tandler, J.: Zur Entwicklungsgeschichte der Drüsen Darmarterien. Anat. Hefte, 1903, Vol. 23, p. 187.  
 Tourneux, F.: Note sur l'épithélium de la vésicule ombilicale. C. R. Soc. Biol., 1889, series 9, vol. 1, p. 197.  
 Winkler, F. N.: Die Zotten des menschlichen Amnion. Jenaische Zeitschr. f. Med. u. Naturw., 1868, vol. 4, p. 534.

**YOUNG'S NATURAL GAS WELL AND MINERAL SPRINGS.**—Lake County, California.

These natural wonders are located in the eastern edge of Kelseyville on a slightly elevated ground, about three miles south of Clear Lake and near the base of Uncle Sam Mountain. The well is, so far, more of a curiosity than a health resort. While boring for gas, in 1888, the proprietors set free, at a depth of about one hundred and fifty-eight feet, a large volume of water mingled with gas. It rushed out with great force, and the flow has continued, geyser fashion, ever since. For an instant it stops, and then comes another violent ejection to the height of about forty feet; this occurs as often as seventy or eighty times to the minute. The flow of water, which has a temperature of 76° F., is about six thousand gallons per hour. Many people from various localities visit the place to witness the peculiar phenomenon. The water has been extensively used by the people of Kelseyville and vicinity, and they pronounce it excellent for liver, kidney, and bowel disorders. The following analysis of the water was made by Winslow Anderson in 1889. One United States gallon contains (solids): Sodium chloride, gr. 15.76; sodium carbonate, gr. 36.52; sodium sulphate, gr. 19.16; potassium carbonate, gr. 3.40; potassium iodide, gr. 0.78; magnesium carbonate, gr. 7.14; magnesium sulphate, gr. 21.90; calcium carbonate, gr. 6.36; calcium sulphate, gr. 9.72; manganese carbonate, gr. 0.18; ferrous carbonate, gr. 4.95; borates, gr. 3.12; alumina, gr. 5.18; silicates, gr. 6.45; and traces of barium carbonate, lithium carbonate, and organic matter. Total solids, 140.62 grains. Free carbonic acid gas, 9.60 cubic inches; also traces of petroleum and carbureted hydrogen (inflammable gas).

The water may be described as a fairly strong saline chalybeate. If sufficiently palatable it ought to prove useful as a therapeutic agent. Its action is tonic, anti-acid, aperient, and diuretic. It is the owner's intention to establish a health and pleasure resort on the premises. Several inflammable gas wells are also found on the ground. These yield a gas composed largely of light carbureted hydrogen. James K. Crook.

**YUMA, ARIZONA.**—This desert "city" of 1,800 inhabitants lies in the extreme southwestern corner of Arizona, at the junction of the Gila and Colorado rivers. It has an elevation of only 140 feet, and is situated in the Great Arizona Desert, about sixty miles from the Gulf of

dry heat—the dryness of the desert, and hence more endurable than a lower temperature would be in combination with a moist atmosphere. From the table we see, again, that the relative humidity is very low, 40.3 per cent. for the year; and the average rainfall for the year only 2.08 inches, and in some years much less than his. Thus, for example, in 1899, there was only 0.6 inch of rain, 0.5 of which fell in November. (Hinsdale, "System of Physiologic Therapeutics, Climatology.") The winter climate, the season in which an invalid would seek such a resort, is sunny and mild, the average temperature being 56.1° F., about five degrees higher than that at Phoenix for the same season, and about two degrees lower than that of Cairo, which is 58.3° F.

CLIMATE OF YUMA, ARIZONA. LATITUDE, 32° 45'; LONGITUDE, 114° 36'.—PERIOD OF OBSERVATION, EIGHT YEARS.

	Jan.	Feb.	March.	May.	July.	August.	Oct.	Nov.	Dec.	Year.
Temperature—(Degrees Fahr.)										
Average or normal	53.5°	59.0°	65.0°	77.3°	92.4°	91.0°	72.0°	60.5°	56.0°	72.1°
Mean of warmest	60.3	65.0	71.8	81.8	94.0	92.7	77.0	65.4	59.3	74.0
Mean of coldest	50.2	52.2	58.3	74.4	89.6	88.6	66.7	56.7	52.8	70.2
Average daily range	10.1	12.8	13.5	7.4	4.4	4.1	10.3	8.7	6.5	3.8
Highest or maximum	80.0	90.0	100.0	108.7	118.0	115.0	102.0	91.0	80.0	
Lowest or minimum	22.5	25.0	31.0	49.0	61.0	64.0	41.4	31.0	27.0	
Humidity—										
Average relative	44.6%	42.2%	41.6%	33.8%	39.3%	42.3%	40.1%	38.9%	44.6%	40.3%
Precipitation—										
Average in inches	.43	.52	.08	.01	.22	.25	.04	.03	.31	2.08
Wind—										
Prevailing direction—From	N.	N.	W.	W.	S.	S. E.	N.	N.	N.	
Average hourly velocity in miles	5.6	7.0	5.9	5.8	6.0	5.5	4.4	5.2	4.9	5.5
Weather—										
Average number clear days	20.8	19.2	23.1	28.0	22.5	21.8	24.1	22.8	22.4	282.4
Average number fair days	8.1	6.6	6.6	2.6	7.8	7.7	6.1	5.8	6.9	66.3
Average number clear and fair days	28.9	25.8	29.7	30.6	30.3	29.5	30.2	28.6	29.3	351.7

California and a few miles from the Mexican border. It is on the line of the Southern Pacific Railroad.

Like Phoenix in the same State, Yuma is famed for its sunshine, heat, and dryness. It can be used only as a winter resort, for it is excessively hot in the summer, the thermometer sometimes rising as high as 115° F. or over, and for many days in succession it ranges above 90° F.

Such a region and climate present conditions closely resembling those which are found at the health resorts of Egypt, which are in nearly the same latitude. The accommodations in the latter country, however, are vastly superior in abundance and excellence to those at Yuma, which are insignificant in comparison, although we are told that "ample accommodation is had at the Depot Eating House, situated on the very bank of the Colorado, with encircling balconies for enjoyment of guests." One would hardly choose, however, a railroad station for a pulmonary invalid seeking pure air free from dust. What other suitable accommodations, if any, exist is unknown to the writer. There is little at Yuma to attract one in the way of amusements or diversion. Such vegetation as is found here is of a semitropical nature. The soil is that which is peculiar to all desert regions.

The climate is that typical of the desert in a tropical latitude, and presents many interesting phases for study. In the first place, we observe from the chart that there are 282.4 clear days, and 351.7 clear and fair days, or over 90 per cent. The mean number of cloudy days for 6 years was 21 (Solly). One may therefore enjoy here almost continuous sunshine. What a contrast, for instance, to Sitka, Alaska, where there are only 66 clear days on an average during the year! Secondly, the extraordinary heat of the warmer months of the year is to be noticed, the temperature in the shade having been known to rise as high as 118° F.; and in the year 1893, from April to October inclusive, out of 214 days, there were 163 during which the thermometer stood above 90° F., and the maximum temperature for the year was 111° F. (Solly, "Medical Climatology.")

It is to be borne in mind, however, that this is a very

For a comparison of the climate of this desert region of Arizona with that of the winter resorts of Egypt, the reader is referred to the article on the latter country in Vol. III. of this HANDBOOK. It will be seen how closely the climatic characteristics of these two regions resemble each other; both illustrate the features of a warm desert climate, and with equally good accommodations and attractions both would probably produce similar results in the treatment of disease.

The conditions and diseases for which such a climate as that to be found at Yuma is to be recommended are also those for which the Egyptian climate is favorable. All stages of phthisis may be favorably influenced by a residence in this desert climate, provided the conditions are not acute. As in Egypt, the disadvantage of such a resort is the short time of year during which it is available; this is a distinct objection in the treatment of phthisis, although even with this disease change is sometimes desirable and advantageous, and this is oftener true of many other maladies. Change *per se* is a therapeutic resource of no mean value.

For the consideration of the climate of Arizona as a whole, the reader is referred to the article on Arizona in Vol. I. of this HANDBOOK. Edward O. Otis.

**ZEAL.** See *Corn Silk*.

**ZEDOARY.**—(*Rhizoma Zedoaria*, P. G.) The rhizome of *Curcuma Zedoaria* Roscoe, order Zingiberaceæ. This is one of the numerous ginger-like plants which inhabit the warmer parts of Asia, and whose rhizomes or seeds are used as spices or condiments. Zedoary is indigenous in India and China, in which places it is also cultivated. It is introduced and cultivated also in Java and other Pacific islands. The rhizome is the part used, being dug up, washed, or scraped, and then sliced and dried. It is commonly stated that the smaller branches form the "long Zedoary," and the central tubercles or clumps the "round Zedoary"; but, according to the French Codex and some other authorities, the latter is the rhizome of a related plant, *C. aromatica* Salisbury. Zedoary comes



also occasionally mixed with curcuma. The long variety of Zedoary is of old occurrence in commerce, and was formerly a greater favorite than now, when its place is mostly taken by ginger, curcuma, sweet flag, etc. In this country, indeed, it is wellnigh obsolete, but on the continent of Europe it is still official in most countries, although but very little used.

It figures mostly in external applications as an ingredient of several proprietary liniments and "balsams." The French "*Baume de Fioravanti*" contains zedoary along with fifteen other resins and spices.

In its composition zedoary resembles ginger and curcuma, and like these it contains an abundance of starch.

W. P. Bolles.

#### ZEM ZEM SPRINGS.—Lake County, California.

These springs are located on the southeastern side of Clear Lake, and take their name from the Holy Well in Mecca. The waters have a temperature of 64° F., and, according to an analysis said to have been made by Dr. Boon, they contain the following ingredients: One United States gallon contains: Sulphur, gr. 291.15; iron, gr. 157.50; magnesia, gr. 163.24; solid matter, gr. 612.15. Total solids, 1,224.04 grains.

They have some notoriety in the treatment of dyspepsia, rheumatism, and diseases of the liver and kidneys.

James K. Crook.

**ZENKER'S NECROSIS.** See *Muscle, Pathology of, and Necrosis.*

**ZINC.**—I. GENERAL MEDICINAL PROPERTIES OF COMPOUNDS OF ZINC.—Charging the blood with zinc affects nutrition in excess, developing poisonous symptoms, but the action is not so profound as with the majority of the heavy metals, and in medicinal dosage deleterious effects need not be feared. Therapeutically, the constitutional influence shows itself in a tendency—not very strongly pronounced, but still useful—to abate spasmodic nervous disorders, such as epilepsy, chorea, hysteria, etc. Indeed, before the rise of bromides into medicinal prominence, zinc was a standard medicine for the relief of epilepsy and hysteria. At present, it can only be said that, among the heavy metals, zinc combines more potency and availability as a constitutional nerve than any other—which is not saying much. Locally, the properties of the zinc compounds differ with the chemistry of the different compounds, mainly according to solubility, the soluble salts being caustic or irritant and astringent, and the insoluble compounds operating as absorbent, soothing, healing, and disinfectant dressings. Internally, the soluble compounds in moderate dosage determine prompt and thorough vomiting, after the manner of copper salts, though with less severity of action. In large doses they are corrosive or irritant poisons, according to the activity of the individual compound. The insoluble compounds in small dose allay gastric and intestinal irritability, but in large dose, probably through chemical conversion, may nauseate, and even vomit. Zinc compounds are disinfectant, the soluble salts, especially the chloride, notably so, and since they do not stain they are the most generally available of metallic salts for the purpose.

The therapeutics of zinc consist of the following applications: *constitutionally*, as a medicine of second- or third-rate power to control spasmodic nervous disease; *in the stomach*, to allay pain or nausea, for which purpose an insoluble compound is commonly selected; *in the bowels*, to control diarrhoea, especially when the affection seems a reflex of nervous irritation rather than the expression of a catarrh; and, *externally*, the soluble compounds, to cauterize, or, to perform the usual functions of a metallic astringent irritant in the way of determining absorption of granulation tissue, and abating catarrh; and the insoluble preparations to act as soothing, healing, or, applied dry, absorbent and disinfectant dressings. Solutions of the soluble salts are also available as efficient disinfectants of their kind for wounds, fabrics, floors, and all non-metallic receptacles.

II. THE COMPOUNDS OF ZINC USED IN MEDICINE.—These are the *oxide, carbonate, chloride, bromide, iodide, sulphate, acetate, valerianate, and phosphide*, and although not official, the *nitrate and oleate*.

**Zinc Oxide (ZnO).**—Zinc oxide is official in the United States Pharmacopœia as *Zinci Oxidum*, Zinc Oxide. It is a smooth white powder, odorless and tasteless, and insoluble in either water or alcohol. It dissolves in acids without effervescence. It is permanent in the air, but should be kept in well-stoppered bottles. Zinc oxide is a commercial article, and impure and even fraudulent specimens are not uncommon. Zinc oxide is the principal insoluble zinc compound. It may be used, given internally, for the constitutional effect of zinc, or to allay vomiting or diarrhoea; dose, from 0.06 to 0.30 gm. (gr. i.-v.), several times a day, in powder or pill. Externally, zinc oxide may be used, alone or mixed with powdered starches or gums, as an absorbent powder dressing to excoriations and sores, or, in ointment, as a soothing and healing application, for which purpose it is very efficient. There is an official ointment, *Unguentum Zinci Oxidi*, Ointment of Zinc Oxide, consisting of twenty per cent. of the oxide in benzoated lard, which may be applied in full strength to sores or eruptions.

**Zinc Carbonate.**—Normal zinc carbonate occurs in the mineral *zinc spar* or *calamine*, which was formerly official in the United States Pharmacopœia, as a medicine, but was dropped, because of its impurities, in the revision of the Pharmacopœia of 1860. In its place is official, now, the mixture of carbonates that results from precipitating a boiling solution of zinc sulphate by sodium carbonate. Such precipitate is entitled *Zinci Carbonas Precipitatus*, Precipitated Zinc Carbonate. Precipitated zinc carbonate is, like the oxide, a smooth, white powder, without odor or taste, and insoluble in water or alcohol. It dissolves in acids with copious effervescence. Zinc carbonate is substantially a duplicate of the oxide in medicinal properties, but its use is commonly confined to external application as an absorbent powder.

**Zinc Chloride (ZnCl<sub>2</sub>).**—The salt, commonly called *but-ter of zinc*, is official in the United States Pharmacopœia as *Zinci Chloridum*, Zinc Chloride. It occurs in a white crystalline powder, or in white, opaque lumps, and is exceedingly deliquescent. It is odorless, but has a very caustic saline and metallic taste (but it is so corrosive that tasting is dangerous). It dissolves very freely in water and in alcohol. It should be kept in small, glass-stoppered bottles. The chloride is the most active of the zinc salts, being highly corrosive and antiseptic both. It has little effect on the sound skin, but upon a raw surface or mucous membrane it disorganizes tissues, forming a white, tough slough. The action, though powerful, is not diffuse, so that it can be regulated quite exactly in area and depth. The slough remains odorless during its attachment, and, when finally cast off, as happens in a week or ten days, exposes an underlying surface presenting clear, healthy granulations, which rapidly proceed to cicatrization. Zinc chloride thus makes an excellent escharotic, combining the features of being powerful, yet manageable, of disinfecting its own slough for determining kindly healing of the resulting ulcer, and of being free from danger of producing constitutional poisoning. Its operation is, however, very painful. In solution, zinc chloride is a standard disinfectant, but, if strong, acts upon metallic surfaces. Internally, it is a corrosive or irritant poison, according to concentration.

For use as a caustic, patent lint may be soaked in a concentrated solution of the salt, dried, and then cut—with an old, worthless pair of scissors—into proper size and applied to the part, which, if covered with skin, must first have the epithelium removed by blistering. Much more convenient, however, is the plan of making the chloride into a paste with flour and water. Such paste can be applied moist, or may be dried and cut into pointed rods, which are then available for thrusting into any large mass requiring destruction, such as a cancerous tumor. This paste was devised by a Dr. Canquoin, of Paris, and often goes by his name. It is made by rapid

admixture of zinc chloride and wheat flour with a very little water—a few drops only to the ounce of paste. The strength in zinc salt will range from fifteen to thirty per cent., according to the character of the tissue requiring destruction.

As a disinfectant, zinc chloride can be prescribed in the official *Liquor Zinci Chloridi*, Solution of Zinc Chloride. This is a solution of the salt in water, fifty per cent., by weight, in strength. It is made directly from the metal by the action of hydrochloric acid, the resulting solution being purified from contaminating iron by a special procedure, and brought to standard strength by distilled water. The solution is a clear, colorless liquid, odorless, having a very astringent, sweetish taste and an acid reaction. In its pharmacopœial strength, this solution is entirely too strong for direct application, being, indeed, corrosive. As a general disinfectant, it should be diluted to three-per-cent. strength, and as a lotion for wound surfaces or ulcers to one per cent. It has the merit of being deodorant and disinfectant, while at the same time it has no smell, does not stain, and, in the dilution enjoined, does not attack fabrics nor injure metallic receptacles.

**Zinc Bromide (ZnBr<sub>2</sub>).**—Zinc bromide is official in the United States Pharmacopœia as *Zinci Bromidum*, Zinc Bromide. It is a white, or nearly white, granular powder, very deliquescent, odorless, having a sharp saline and metallic taste, and a neutral reaction. It is very soluble in water and in alcohol. Because of its ready deliquescence, the salt should be kept in small glass-stoppered bottles. Zinc bromide closely resembles the chloride in general properties, being deliquescent and highly irritant. Its official recognition is, however, not for its duplicature of the chloride in uses, but for its internal employment in nervous disease, with the notion of getting the combined antispasmodic effect of zinc and a bromide. But in the small dosage which the character of salt enjoins, the quantity of bromine ingested is medicinally insignificant. The salt is given in doses of from 0.10 to 0.30 gm. (gr. iss. to v.) in syrupy solution.

**Zinc Iodide (ZnI<sub>2</sub>).**—Zinc iodide is official in the United States Pharmacopœia as *Zinci Iodidum*, Zinc Iodide. This is, again, a white, granular and very deliquescent powder, odorless, but of a sharp, saline, and metallic taste. It is very soluble in water and in alcohol. It must be kept in small glass-stoppered bottles. Zinc iodide, like the bromide, resembles the chloride in quality; but, like the bromide, is suggested for the purpose of getting the effects of the acid radical along with those of zinc, in constitutional medication. But, again, the necessarily small dosage defeats the purpose. The salt is given in doses of from 0.10 to 0.30 gm. (gr. iss. to v.) in syrup. Locally, the iodide has been applied for the general purposes of the metallic astringents, in solutions ranging in strength from the one-fifth of one per cent. to six per cent., or in a twelve-per-cent. ointment.

**Zinc Sulphate (ZnSO<sub>4</sub>.7H<sub>2</sub>O).**—Zinc sulphate is official in the United States Pharmacopœia as *Zinci Sulphas*, Zinc Sulphate. It is crystalline, occurring in small, colorless, right rhombic prisms, or acicular needles which slowly effloresce in dry air. It is odorless, but has a sharply saline, metallic, and nauseous taste. It dissolves in 0.6 part of cold water and in 0.2 part of boiling water. It is insoluble in alcohol. It should be kept in well-stoppered bottles. Zinc sulphate is the sulphate whose commercial impure variety is called *white vitriol*. The pure quality, official as above, is in the small crystals described, which look not unlike those of Epsom salt. Zinc sulphate is decomposed by alkalis and their carbonates, hydrosulphates, lime water, soluble lead salts, and vegetable astringents. By heating, it can be made to part with its water of crystallization, forming what is called *dried zinc sulphate*.

Zinc sulphate is an irritant astringent, and, in the dried form, is even caustic, though less powerfully so than the chloride. Internally, in moderate dose, it is emetic; in excessive quantity, an irritant poison, though again less potent than the chloride. The salt is a favorite metallic

astringent, being milder than copper or silver salts, of less harsh taste, and does not stain. It has thus a wide range of applicability, but yet, where a powerful action is wanted, it is distinctly inferior to silver nitrate or copper sulphate. The crystals are too small to permit the salt to be used in solid form; it is therefore used locally in solution, the strength ranging from the one-fifth of one per cent. to about four per cent. Dried zinc sulphate has been employed as a caustic, made into paste, with one-eighth part of glycerin, or into ointment with one-fourth part of lard. Internally, the salt—crystalline form—may be given for the constitutional effects of zinc, in doses of from 0.015 to 0.06 gm. (gr.  $\frac{1}{4}$  to i.), several times a day; or as an emetic in doses of from 1 to 2 gm. (gr. xv. to xxx.).

**Zinc Acetate (Zn[C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>]<sub>2</sub>.3H<sub>2</sub>O).**—Zinc acetate is official in the United States Pharmacopœia as *Zinci Acetas*, Zinc Acetate. It occurs in soft, white, pearly, six-sided tablets and scales, which effloresce somewhat in dry air. It has a faint, acetous odor and a sharp, metallic taste. It dissolves in 2.7 parts of cold water and in 1.5 parts of boiling water; in 36 parts of cold alcohol and in about 3 parts of boiling alcohol. It should be kept in well-stoppered bottles.

Zinc acetate is practically a duplicate of the sulphate; but its use has been rather restricted by custom to local application for the purposes of the metallic astringents. Solutions may be employed of the same strength as of the sulphate.

**Zinc Valerianate (Zn[C<sub>8</sub>H<sub>9</sub>O<sub>2</sub>]<sub>2</sub>.H<sub>2</sub>O).**—The salt is official in the United States Pharmacopœia as *Zinci Valerianas*, Zinc Valerianate. It is in soft, white, pearly scales, permanent in the air. It has a faint odor of valerianic acid, and a taste at first sweet, then styptic and metallic. It dissolves in about 100 parts of cold water and in 40 parts of cold alcohol. Boiling in either solvent determines loss of acid and the formation of a basic salt, with resulting turbidity of the solution. The salt should be kept in small, well-stoppered bottles. From its comparative insolubility, zinc valerianate is locally less active in every way than the salts typified by the chloride and sulphate. Its place in medicine rests upon the idea of combining in one drug the antispasmodic virtues of zinc and valerian; but since the effects of zinc are feeble at best, and valerianic acid is probably not the active principle of valerian root, there is little ground on which to rest a valid claim for the salt's efficacy. This valerianate also has the positive disadvantages of disagreeable smell and taste, and costliness. The salt has been given in doses of from 0.06 to 0.12 gm. (gr. i.-ij.) several times a day, best in pill.

**Zinc Phosphide (Zn<sub>3</sub>P<sub>2</sub>).**—This salt is of value solely as a means of giving phosphorus, and has been described under the title *Phosphorus*.

**Zinc Nitrate (Zn[NO<sub>3</sub>]<sub>2</sub>.6H<sub>2</sub>O).**—Zinc nitrate forms by the direct action of nitric acid upon metallic zinc. It occurs in colorless prismatic crystals which are soluble in water and alcohol, and are very deliquescent. The salt is fusible, and has been employed, although it is unofficial, in the form of sticks of the fused substance cast in paper moulds, for application to sores and ulcers. The action is caustic and healing, after the manner of silver nitrate. Sticks of zinc nitrate must be kept dry in well-stoppered bottles, else they will be destroyed by deliquescence of the salt.

**Zinc Oleate.**—An oleate of zinc is obtainable in the form of a fine, soapy-feeling powder, of a pearl color. This powder proves to be a serviceable bland absorbent and detergent for local dusting upon the skin.

Edward Curtis.

**ZINC-HEMOL.** See *Hemols.*

**ZINC, POISONING BY.**—The most important salts of zinc, from a medico-legal point of view, are the sulphate and chloride.

*Zinc sulphate*, or *white vitriol* (ZnSO<sub>4</sub>.7H<sub>2</sub>O), is a colorless salt, crystallizing in small four-sided prisms, which



slowly effloresce in dry air. It is soluble in about two times its weight of water at the ordinary temperature, and in less than its own weight of boiling water; insoluble in alcohol, ether, and chloroform. Its taste is astringent and metallic; its reaction, acid.

Zinc chloride ( $ZnCl_2$ ), commonly called *butter of zinc*, is a soft, white, very deliquescent, readily fusible solid, freely soluble in water and in alcohol. Its taste, in the solid state or in concentrated solution, is acrid and corrosive; in dilute solution, astringent and metallic. Its reaction is acid. When brought into contact with raw surfaces or mucous membranes it acts as a corrosive. It has considerable antiseptic power also, and, in an aqueous solution, is frequently used as an antiseptic, deodorizer, and disinfectant. The liquid known under the name of "Sir William Burnett's disinfecting fluid" is such a solution, containing over two hundred grains of the salt in each fluidounce.

Cases of poisoning by these salts have been of rare occurrence and usually the result of accident. Zinc sulphate resembles magnesian sulphate (Epsom salts) very closely in its appearance, and has frequently been taken by mistake for the latter, while Burnett's fluid, which has been the cause of most of the reported cases of poisoning by zinc chloride, has frequently been mistaken for water or other harmless liquid.

**SYMPTOMS.**—Zinc sulphate acts as an irritant poison, but only when a large quantity has been taken. The symptoms are almost entirely local. The most prominent are: an astringent and metallic taste, burning pain in the œsophagus, stomach, and bowels, nausea, vomiting, purging, dyspnoea, small and frequent pulse, and cold extremities. The intellect usually remains clear.

The symptoms usually make their appearance almost immediately after swallowing the poison; but, in rare cases, they have been more or less delayed.

Wormley quotes a case in which vomiting was delayed for fifteen minutes, and there was no purging for ten hours. In this case a solution containing 46.5 gm. ( $\frac{3}{4}$  iss.) of the salt was swallowed. In a case communicated by Lutier active symptoms appeared first after the lapse of fifteen hours.

The symptoms produced by zinc chloride are similar in character to those just described. This salt has, however, a violent corrosive action, which is wanting in the sulphate. The local symptoms are therefore usually more severe than they are in cases of poisoning by the sulphate, and are more frequently followed by symptoms of profound collapse and death. In non-fatal cases recovery may not be complete until after the lapse of several days, or even weeks.

The investigations of C. Ph. Falck, Blake, Letheby, and Harnack show that the salts of zinc paralyze the striated muscles and cause death by their action on the heart and muscles of respiration, without influencing, to any great extent, the central nervous system. F. A. Falck, who experimented with rabbits, found that the temperature of the body is reduced  $7^{\circ}$ - $13^{\circ}$  C. in cases of acute zinc poisoning.

**FATAL QUANTITY; FATAL PERIOD.**—The quantity of any of the preparations of zinc required to endanger life is not exactly known. The sulphate is not a powerful irritant. In large doses it acts as a prompt emetic, and is frequently rejected by the stomach without producing any other serious symptoms. Quantities varying from 4.3 to 124 gm. (gr. lxvij. to  $\frac{3}{4}$  iv.) have been taken without fatal result. Death has occurred in five hours (a child), thirteen and a half hours (adult, 5.8 gm.), thirty-six hours (7.6 gm.), three days (adult, quantity unknown), and five days (adult, 15.5 gm.). The chloride is much more dangerous than the sulphate. Most of the reported cases of poisoning by this salt have been caused by Burnett's solution, and the quantity taken has usually been known only approximately. Recovery has followed the administration of quantities of this solution varying from half a wineglassful to three fluidounces, the quantity of salt varying, so far as known, from 0.8 to 26 gm. (gr. xij.-cd.). Six and one-half grams (gr. c.)

has caused death. Death usually takes place within twenty-four hours. The shortest fatal periods are two hours (Taylor), four hours (Allanson), seven and a half hours (Cousins), ten hours (Letheby). Occasionally the patient has recovered from the primary effects, only to succumb to the secondary effects after the lapse of several weeks. In such cases death usually results from starvation, following upon stricture of the œsophagus, pylorus, or intestines.

**POST-MORTEM APPEARANCES.**—When the sulphate has been taken, the lesions are substantially similar in character to those observed in cases of poisoning by other pure irritants. A slight ulceration, near the pyloric end of the stomach, has been noted in a single case. Rarely, there may be contraction of the stomach or intestines.

The chloride of zinc resembles in its action the mineral acids and caustic alkalis. In cases of poisoning by this salt the mucous membranes of the mouth, throat, œsophagus, stomach, and intestines are usually more or less disorganized. In a few cases, however, there has been an absence of corrosion even in the mouth. Perforation of the stomach, and stricture of the œsophagus, pylorus, and intestines may be met with, especially in cases which are not rapidly fatal. Congestion of the brain and its membranes, and of the lungs and kidneys, are usual sequels of acute poisoning.

**TREATMENT.**—Vomiting should be encouraged if necessary. Sodid carbonate precipitates zinc carbonate from solutions of soluble zinc salts and may therefore be employed as a temporary chemical antidote. In other respects treatment must be symptomatic.

**OTHER COMPOUNDS OF ZINC.**—The remaining soluble salts of zinc are substantially duplicates, in their effects, of the sulphate or chloride.

*Zinc oxide* and *zinc carbonate* are white amorphous solids, insoluble in water, but soluble in dilute acids, the carbonate dissolving with effervescence. Either of these compounds, if taken internally in considerable quantity, may dissolve in the fluids of the stomach and intestines and give rise to acute or subacute poisoning, with the usual symptoms of irritant poisoning.

Chronic zinc poisoning has been ascribed to the long-continued inhalation of the vapors of zinc oxide. This form of poisoning has been observed in workers in zinc, brass, and galvanized iron, and is characterized by headache, chilliness, pains in the extremities, a strong metallic taste, nausea, vomiting, diarrhoea, and colic. It is to be borne in mind in this connection that commercial zinc usually contains lead, and frequently arsenic, and that the above symptoms may be those of poisoning by one or the other of these metals, and not by zinc oxide.

The use of galvanized iron pipes for conveying water, and of galvanized iron utensils for the preparation and storage of food, appears to be attended with some danger. Water that has passed through galvanized iron pipes almost always contains zinc compounds, either in solution or in suspension. There is some difference of opinion as to the effect of such water on health, but it is generally believed that the danger of poisoning from the zinc in solution in the water is very slight. When the water has stood in contact with the pipe for several hours it frequently holds in suspension a considerable quantity of insoluble zinc compounds. It seems probable that the use of such water would be attended with danger. As a precautionary measure, therefore, the water that has stood in contact with a galvanized iron pipe for several hours should be allowed to run to waste, or should be filtered before use.

Certain liquids used in cooking, especially such as contain vegetable acids, may dissolve a sufficient quantity of zinc from galvanized iron utensils to produce symptoms of poisoning. Wormley reports a case of zinc poisoning caused by the use of apple butter prepared with cider which had been concentrated in a galvanized iron pan. The concentrated cider was found to contain 1.14 grains zinc oxide to each fluidounce.

**ABSORPTION AND ELIMINATION.**—When compounds of zinc are taken internally the metal is absorbed, presu-

mably in the form of albuminate, and may be detected, after death, in the blood and in all the tissues of the body. Matzkewitsch administered the acetate of zinc to dogs by subcutaneous injection, and found, as the result of five experiments, that the greater proportion of the zinc thus introduced was localized in the muscles and bones. The skin, brain, liver, heart, lungs, kidneys, bladder, stomach, and intestines contained zinc, but in relatively small quantities. Zinc is eliminated with the urine, bile, and milk (Falck, Harnack). According to Michaelis the metal is first detected in the excretions on the fourth or fifth day after the administration of its compounds. The time required for complete elimination is unknown. According to Popoff it can be detected in the urine for months after removal from its influence.

The study of the localization and elimination of zinc is attended with peculiar difficulties, inasmuch as the human system frequently contains small quantities of the metal even when its compounds have not been purposely administered. Raoult and Breton isolated 7 mgm. of zinc from 700 gm. of human liver in one case; 12 mgm. from 400 gm. of liver in a second case. In four other cases they extracted 10, 30, 34, and 76 mgm., respectively, from 1,000 gm. of liver. Lechartier and Bellamy obtained similar results. In one case 1,780 gm. of liver contained 20 mgm. of zinc oxide. The same authors extracted 30 mgm. of zinc oxide from 913 gm. of muscle from the ox, and 20 mgm. from 1,152 gm. hard-boiled egg. They also detected traces of zinc in corn, maize, barley, and white beans.

The frequent presence of small quantities of zinc in the organs of the body may be explained in some cases by the use of water which has been conveyed through galvanized iron pipes, or by the use of food which has absorbed zinc from galvanized iron utensils; in other cases, by the medicinal administration of preparations of zinc before death, or the introduction of embalming fluids containing salts of zinc, after death.

In consideration of the foregoing facts it is obvious that the detection of zinc in the tissues after death cannot, when unsupported by other evidence, be accepted as proof that death was caused by zinc poisoning.

William B. Hills.

**ZINGIBER.** See *Ginger*.

**ZONIAN SPRINGS.**—Kane County, Illinois.

These springs are three or four in number, and are located one mile north of the city of Elgin, in a fine, wooded, rolling country, about 2,000 feet above the sea-level. The atmospheric temperature varies from about  $75^{\circ}$  to  $80^{\circ}$  F. during the summer, and from  $10^{\circ}$  to  $60^{\circ}$  F. during the winter months. The following analysis of the water was made by J. E. Seibel, analytical chemist, Chicago:

One United States gallon contains (solids): Calcium carbonate, gr. 9.56; iron carbonate, gr. 0.49; magnesium carbonate, gr. 2.49; sodium carbonate, gr. 0.45; sodium sulphate, gr. 1.75; sodium carbonate, gr. 0.70; silica and aluminum, gr. 0.26. Total, 15.69 grains.

It is stated that the water also contains a considerable amount of free carbonic acid. The flow of water amounts to about one barrel per minute from each spring. Kidney, stomach, and liver troubles are said to be benefited by the waters.

James K. Crook.

**ZYMASE.**—In 1897 E. Buchner demonstrated that the phenomena of alcoholic fermentation can be brought about without the presence of living yeast cells or other organized ferments. By subjecting yeast which has been ground up with sand, kieselguhr, and water to a pressure of four hundred to five hundred atmospheres it is possible to collect a fluid free from protoplasmic particles or living matter in any form. When this juice is brought into contact with strong sugar solutions it provokes a vigorous evolution of carbon dioxide ( $CO_2$ ), alcohol ( $C_2H_5.OH$ ) being simultaneously formed in the mixture. The reaction proceeds unaltered even in the presence of one-per-cent. sodium arsenite or of chloroform and other sub-

stances which readily destroy micro-organisms. The activity of the juice is lost by heating above  $40^{\circ}$ - $50^{\circ}$  C. From these facts it follows that the reaction is attributable to an enzyme to which the name *zymase* has been given. Despite the vigorous criticism which the announcement of this discovery speedily provoked, it is now firmly established that ordinary alcoholic fermentation is not a "vital" process of the yeast cell, but is brought about by the intermediation of soluble enzymes. The change which sugars undergo in the presence of yeast has always been pointed out as a typical "fermentation" reaction, in distinction from "zymolytic" (enzymatic) transformations. Accordingly the detection of zymase will emphasize more than ever the wide distribution and significance of enzymes in the life processes; and we may almost confidently expect sooner or later to find a specific enzyme for every vital chemical reaction.

Zymase is already known to occur widely in nature. The observations of Buchner on the yeast have repeatedly been verified; Mazé has isolated zymase from fungi; and Stoklasa and his co-workers have demonstrated its occurrence in many of the higher plants like the sugar beet, as well as in various animal tissues. The importance of this for the carbohydrate metabolism and internal respiration of both animals and plants can as yet scarcely be foretold. It is impossible at the present time, however, to assert that the zymases isolated from the various sources referred to are identical. As far as has been investigated the products of the reaction occur very nearly in the proportions demanded by the equation  $C_6H_{12}O_6 = 2C_2H_5.OH + 2CO_2$ , only small quantities of side products being found. It seems likely that one of these, lactic acid, owes its existence to the activity of a specific enzyme.

Zymase may be isolated by the method of Buchner and Albert. The intracellular juices obtained by the method already indicated are treated with alcohol and ether, and the precipitate containing the enzyme is dried at a low temperature. The details of the method as applied to various animal and vegetable tissues must be consulted in the original papers. The glycolytic enzyme in animal tissues like the heart, lungs, etc., may also be demonstrated by immersing the sterile tissue in a sterile sugar solution in an atmosphere of hydrogen. The evolution of  $CO_2$  and the formation of alcohol are then readily demonstrated. Experiments of this sort serve to awaken interest in the possible formation of alcohol in the intermediary metabolism of animals.

Although dried preparations of zymase retain their glycolytic properties for a long time, solutions of yeast zymase soon lose their power if a proteolytic enzyme (like yeast endotrypsin) is simultaneously present. Compared with equivalent portions of yeast, the cellular juices containing zymase are less efficient as fermentative agents. This is doubtless attributable to the constantly renewed production of enzyme in the case of the living cells. Zymase may readily be demonstrated in carefully dried yeast in which all the cells are dead. A method for making a permanent sterile preparation of this sort by the use of acetone (Aceton-Dauerhefe) has been devised by Albert.

Lafayette B. Mendel.

#### LITERATURE.

A review of the literature on the zymase of yeast will be found in Die Zymasegärung, von Ed. und Hans Buchner und Martin Hahn, München, 1903. Further: E. Buchner: Berichte der Deutschen chemischen Gesellschaft, 1897, xxx. (Discovery of zymase.) Mazé: Comptes rendus, cxxxv. (Zymase in fungi.) Stoklasa, Jelinek, and Vitek: Hofmeister's Beiträge zur chemischen Physiologie, 1903, iii., 460. (Zymase in plants.) Stoklasa and Cerny: Centralblatt für Physiologie, 1903, xvi., 652. (Zymase in animal tissues.) Stoklasa, Jelinek, and Cerny: *Ibid.*, 712. (Lactic-acid-forming enzyme.) R. O. Herzog: Zeitschrift für physiologische Chemie, 1903, xxxvii., 381. *Ibid.*

**ZYMOGENS.**—This generic name has been applied to the precursory stage in which the enzymes are present in the cells of secretory glands. In this condition, there is no activity, but in the process of secretion, or in some in-



stances after the secretion is thrown out upon the mucous surface and has come in contact with activating substances present in other secretions with which it is mixed, the zymogen undergoes a chemical change, the nature of which is unknown, by which the active ferment is formed. Such a conversion into active ferment can also be produced artificially in many instances by treating the fresh gland with very dilute acetic acid, or it occurs spontaneously on allowing the gland to remain for some hours after removal from the body, especially if it be kept during this interval at body temperature.

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The presence of zymogens has been known now for many years, and recently great advance has been made in our knowledge of the conditions under which they are set free (see for example, enterokinase, in the article on *Pancreas, Physiology of*).

For further information on zymogens, see the article on *Enzymes*. Benjamin Moore.

**ZYMOLYSIS.**—This is a general term used to designate the changes produced by enzymes. See articles on *Digestion*, on *Enzymes*, and on *Pancreas*. B. M.

APPENDIX.

Alaska.  
Alaska.

**ALASKA.**—This vast northwestern possession of the United States, extending over 16 degrees of latitude and 35 degrees of longitude, and embracing 590,884 square miles of territory, equal to nearly one-sixth of the area of the United States, exhibits a variety of climatic conditions and contrasts dependent not only upon latitude, but upon the topography of the country and the influence of the surrounding waters and currents. Two great climatic divisions can be made: southern or temperate Alaska, which can be subdivided into the Sitka, Kadiak, and Aleutian divisions, and northern Alaska or the Yukon district, embracing the vast region to the north and west of the Alaskan Mountains.

The climate of temperate Alaska is characterized by two striking peculiarities: comparative warmth and great moisture, caused by the Kuro Siwo, the "Gulf Stream" of the Pacific. This current crosses the Pacific in about latitude 45° N., and impinges on the coast of British Columbia where it divides, one portion turning northward and westward and the other southward. As a result of this condition, the temperature is greatly modified from what the latitude alone would lead one to expect, exactly as the climate of Great Britain, for example, is modified by the gulf stream. The isotherm of 40° mean annual temperature, that of the lower St. Lawrence valley, is the mean annual isotherm of the Southern Alaskan coast region. Sitka, with a latitude of 57.03°, which is the same as the latitude of Labrador on the Atlantic coast, has a mean annual temperature of 43.9° F., which is only 2.6° lower than that of Portland, Me., and a mean winter temperature of 32.5°, which is 6.9° higher than that of Portland, and only a little less than that of Washington, D. C. The extreme range of temperature is from a point a trifle below zero to 90° above. Similarly, Juneau, in the Sitka district, northeast from Sitka, has a mean annual temperature of 40.9° F. The annexed chart of the maximum, minimum, and mean temperatures of Juneau and Sitka for the year indicate still further the moderate temperature of the region.

The second peculiarity of temperate Alaska is moisture in the form of rain or fog, and in the Sitka division, which extends from Dixon Entrance to William's Sound, the yearly rainfall is from eighty to one hundred and three inches, and there are on an average but sixty-six clear days in the year. "When the sun shines, the atmosphere is remarkably clear, the scenic effects are magnificent, all nature seems to be in holiday attire. But the scene may change very quickly; the sky becomes overcast; the winds increase in force; rain begins to fall; the evergreens sigh ominously, and utter desolation and loneliness prevail." [United States Department of Agri-

culture, Weather Bureau.] The Sitka district is very mountainous, and the coast bold and steep with few beaches. The mountain sides are densely wooded, and the snow line begins at an elevation of from three thousand to five thousand feet. The prevailing winds being westerly and off the ocean, bring the moisture to the snowy mountains, which condense it. Hence it is the combination of the mountains, the prevailing moist winds from the sea, and the warm Japan current, which results in this enormous rainfall, nowhere else equalled in the United States, the annual rainfall at Sitka being more than double that on the Atlantic coast. At Sitka the rainfall for the three winter months is about thirty inches, and for the three summer months sixteen inches.

The Sitka region is the scenic portion of Alaska, visited by tourists, and here are found immense glaciers descending into the ocean.

The country is heavily wooded with spruce, hemlock, and cedar, and the vegetation is dense. On account of the sparse sunshine agriculture is difficult, but many garden vegetables are successfully grown.

In the Kadiak district, which comprises Cook's Inlet, the peninsula of Alaska, and the Kadiak Islands, the climate is similar to that of the Sitka region, but there is more sunshine and less rain, and the seasonal extremes of temperature are greater. At Kadiak the annual mean temperature is 40.6° F., and the number of days of rain or snow for ten months of the year 1899 was 133, and the number of cloudy days 124, making 257 cloudy and rainy days out of 304. The monthly mean temperature at Kadiak for eight years is as follows:

KADIAC—LAT. 57° 48'; LONG. 152° 19'. MONTHLY MEAN TEMPERATURE (DEGREES FAHRENHEIT) FOR EIGHT YEARS.

January	30.0	August	55.2
February	23.2	September	50.0
March	32.6	October	42.3
April	36.3	November	34.7
May	43.2	December	30.5
June	49.5	Year	40.6
July	54.7		

In the Aleutian district, comprising the range of Aleutian Islands, the range of temperature is much the same, as the following chart of Unalaska indicates:

UNALASKA—LAT. 53° 54'; LONG. 166° 24'. MONTHLY MEAN TEMPERATURE (DEGREES FAHRENHEIT) FOR SIX YEARS.

January	30.0	August	51.9
February	31.9	September	45.5
March	30.4	October	37.6
April	35.6	November	33.6
May	40.9	December	30.1
June	46.3	Year	38.7
July	50.6		

AVERAGE MONTHLY MAXIMUM, MINIMUM, AND MEAN TEMPERATURES (DEGREES FAHRENHEIT) OF JUNEAU AND SITKA FOR THE FOUR YEARS 1899-1902 INCLUSIVE.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Juneau—												
Mean maximum	41.7°	43.0°	50.7°	57.2°	66.2°	73.2°	78.5°	67.7°	63.7°	58.7°	49.6°	47.6°
Mean minimum	9.5	12.0	6.0	29.5	33.2	39.2	44.0	41.7	35.7	27.0	19.3	11.0
Daily mean	29.7	29.1	32.8	40.6	46.6	56.6	57.5	54.2	49.8	43.0	35.9	32.6
Sitka—												
Mean maximum	51.0	47.3	53.6	58.0	64.7	67.7	78.5	65.2	60.0	54.0	49.7	49.7
Mean minimum	23.3	16.3	7.6	28.3	31.2	34.7	40.0	39.7	37.7	30.5	23.3	21.3
Daily mean	35.7	34.3	35.8	42.0	44.6	50.6	55.5	54.4	50.9	45.2	38.0	34.3