SYLLABUS

— OF —

Lectures in Anatomy and Physiology,

— FOR —

STUDENTS

— OF THE —

State Normal and Training School,

— AT —

CORTLAND, N. Y.

— BY —

T. B. STOWELL, A.M.

SYRACUSE, N. Y.
DAVIS, BARDEEN & CO., PUBLISHERS.
1877.

SYLLABUS

— OF —

Lectures in Anatomy and Physiology,

— FOR —

STUDENTS

— OF THE —

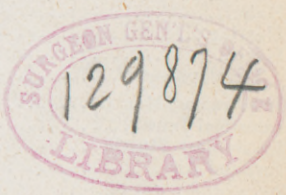
State Normal and Training School,

— AT —

CORTLAND, N. Y.

— BY —

T. B. STOWELL, A.M.



SYRACUSE, N. Y.
DAVIS, BARDEEN & CO., PUBLISHERS.
1877.

INDEX.

INTRODUCTION.

This Syllabus has been prepared with direct reference to aiding my classes in Anatomy and Physiology.

It is hoped that greater efficiency as well as economy of time may be secured by giving directness to inquiry, and by calling special attention to items of chief importance.

The Syllabus is to be used in connection with demonstrations in Anatomy, charts, diagrams, stereopticon views, and the microscope. It is not a substitute for works of reference, text books, or notes; it is simply an aid: hence, where little would be gained other than orthography, terms have been omitted, e. g., no mention is made of the names of muscles, which are studied in class with the aid of manakin and alcoholic preparations; the names of most of the bones are likewise omitted, all of which are studied from the skeleton.

T. B. S.

Cortland, N. Y., July, 1877.

SYLLABUS.

I. SKELETON.

Items to be noted concerning each bone.

1. Name. 2. Location. 3. General Shape. 4. Articulations. 5. Processes.

Class I.

Order for Study.

Posterior.	Femur.	Anterior.	Humerus.
	Tibia.		Radius.
	Fibula.		Ulna.
	Metatarsal.		Metacarpal.
	Phalanges.		Phalanges.
			Clavicle.

Long Bones.

Structure—Shaft.

Compact tissue, spongy tissue, medullary canal.

Expanded extremities—Serial homologies—System of levers.

Class II.

Tarsal bones, *distal row*—Cuneiform, outer, middle, inner, Cuboid.

Carpal bones, *distal row*—Trapezium, Trapezoid, Magnum, Unciform.

Tarsal bones, *proximal row*—Astragalus, Scaphoid, Calcis (calcaneum).

Carpal bones, *proximal row*—Scaphoid, Semi-lunar, Cuneiform, Pisiform (sesamoid).

Short Bones.

Structure.

Compact tissue thin, chiefly spongy.

Serial homologies—Interarticulations—Limited motion.

Class III.

Flat Bones.

Structure.

Two surfaces of compact tissue, intermediate cancellous, thickness slight. Protection, and surface for muscular attachment.

Class IV.

Irregular Bones.

Structure.

Externally compact tissue, internally cancellous.

Vertebra.

1. Centrum—Surfaces.

Anterior (upper) and posterior (lower) concave, ventral (front) transversely convex, longitudinally concave, dorsal (back) arch, etc.

Character of centrum in the several regions.

Cervical, in atlas wanting (?), in axis peculiar odontoid process. Is it centrum of atlas? its distinctive mode of ossification (in man), two separate lateral pieces—dorsal and lumbar, relative length and breadth—ankylosis of sacral and caudal.

Intervertebral cartilage,

(Wanting between atlas and axis.)

2. Arch—Pedicles and lamina—Intervertebral foramina for spinal nerves —Relative length and breadth in cervical, dorsal and lumbar regions— Groove in 1° cervical lamina for vertebral artery.

3. Processes—(a.) Spinous.

In cervical region, bifid, diminutive in 1°, long and grooved in 2°, general increase in length to 7°—in dorsal region, directed obliquely backward—in lumbar region, short, broad, directed nearly at right angles with longitudinal axis.

(b.) Articular—at union of pedicle and lamina—anterior and posterior vertebrae distinguished by direction of faces of "zygapophyses."

(c.) Transverse—at junction of articular process and pedicle—characteristic position and direction in the three regions.

In cervical, ventral to articular—perforations for vertebral artery—in dorsal, dorsally disposed—in lumbar, ventral to (in front of) articular, direction dorsal and transverse.

Development of Vertebra.

Primitive dorsal groove in germinal membrane from 'middle blastoderm cells' converted into canal by union of edges—In floor of canal "notochord" developed—Appearance of dark cellular masses, primordial vertebrae—Disappearance of lines of demarcation in masses—Intermediate limits of permanent vertebrae—Vertebra formed from adjacent parts of two primordial masses.

Essentially three pieces to each vertebra.

From one develops greater part of centrum, from other two the arch and processes.

II. BONE STRUCTURE.

Tissues.

1. Compact.

Exterior of bones, cells small, earthy matter abundant.

2. Cancellous.

Interior of bones, cells large, earthy matter less.

Chemical elements.

1. Inorganic.

Earthy matter gives hardness and solidity.

2. Organic.

Animal matter gives toughness and elasticity.

Microscopic structure.

1. Haversian canals.

In compact osseous tissue—*Size*, $\frac{1}{200}$—$\frac{1}{2000}$ in., average $\frac{1}{500}$ in.—*Arrangement*, in long axis of long bones—*Lining membrane*, continuous with periosteum—*Office*, contain vessels, communication between periosteum and medullary canal.

2. Lamellae.

Concentric rings around canals—successive layers of bone.

3. Lacunae.

Dark spots in and between lamellae—connected by canaliculi—occupied by nucleated cells.

Blood Vessels.

Enter bones,

Near articular surface (usually).

Emerge,

By large veins which accompany the arteries—by small veins at the extremities—by small veins from vessels in compact tissue.

Periosteum.

Thick in young bones—Thin in old bones—Protection to vessels before distribution to bone.

Mode of development.

Intra-cartilaginous—Intra-membranous.

Growth.

Longitudinal,

In cartilage at either extremity.

Circumferential,

Deposition of material under periosteum.

III. TEETH.

Temporary set.

Number—General character of.

Permanent set.

1. Crown.

Distinctive form in the several classes of teeth—covering enamel.

2. Neck.

Constricted portion between crown and fang—attachment to gum.

3. Fang.

Implanted in alveoli—lining periosteum of alveolar depression reflected upon fang—pressure upon crown distributed equally by taper of fang—blood vessels and nerves enter through apex.

Structure.

1. Central pulp cavity.

Dental pulp, vascularity, sensitiveness, vessels, nerves.

2. Solid part—(a.) Enamel.

On exposed crown only, thickest on grinding surface—microscopic prisms, almost wholly mineral, arrangement nearly perpendicular to surface, in waving lines—calcareous "cuticle of enamel" on surface.

(b.) Dentine.

Principal part—fine tubules in matrix, open internally into pulp, externally radiate in curves and undulations, near periphery inosculate in loops, general direction nearly at right-angles to surface—matrix, translucent, penetrated by fine branches of tubules.

(c.) Cement.

Modified bone cells.

Development and Growth.

IV. CARTILAGE.

Temporary.

Its office—Structure.

Fibres, corpuscles 2–3 times size of blood corpuscles, granular uniting matter, fibrous perichondrium–future periosteum.

Arrangement and distribution of vessels during ossification.

Permanent.

Structure.

Nucleated cells, their arrangement in groups—cartilage capsule—matrix–intercellular substance "Cartilagine"—no nerves.

Classes. 1. Fibro-cartilage, (a.) Articular.

In joints—general shape—attached surface rough—free surface smooth—no blood vessels.

(b.) Connecting.

E. g. between vertebrae.

(c.) Circumferential.

E. g. around glenoid cavity—deepens socket.

(d.) Sesamoid.

Lining grooves.

2. Costal,

Of ribs.

3. Reticular,

E. g. ear, nose, etc.—structure—office.

V. MUSCLES.

Items concerning each muscle.

1. Name. 2. Origin. 3. Insertion. 4. Action.

Classes.

I. Involuntary or Plain.

Color pale—fibres prismatic—cells elongated, contractile, nucleated—oblong corpuscles—no sarcolemma.

II. Voluntary or Striated. 1. Sheath, Perimysium

Yellow elastic fibre in investing portion, white fibre in penetrating portion.

2. Fibre. (a.) Arrangement.

In fasciculi—prismatic in figure—composed of threads—fibrillae—fasciculi do not interlace in voluntary muscle.

Fibres run nearly parallel, when depth is slight.

Fibres diverge, when depth is considerable, e. g. bladder of frog.

(b.) Length.

Mean length, .084—.089 mm., .003 in.

(c.) Breadth.

Mean breadth, .004—.007 mm., .0001—.0003 in.

(d.) Nucleus.

Form, single (generally), or rod-shaped—structure, homogeneous except granules, nucleoli.

(e.) Ultimate structure of fibre,–fibrillae.

(1) Sheath–sarcolemma or myolemma.

(2) Sarcous elements, not hollow—length $\frac{1}{17000}$ in.—$\frac{1}{20000}$ in.—alternate light and dark bands of equal breadth—shade due to focal adjustment—line of dark dots intermediate—connection of elements by "connecting material"—ends of fibrillae introduced between two adjoining fibres near their dilated regions—sections of fibrillae transverse, show rings and sections of nuclei, longitudinal, show fibres and elongated nuclei.

(f.) Vessels.

Capillaries do not penetrate fibres— nutriment by imbibition—lymphatics few, in largest muscles loops from plexuses between fibres.

(g.) Nerves.

Contain "dark edged tubules"—known by nuclear enlargement–ganglia (?)

Distribution.

Smooth muscular fibre through body, in posterior wall of trachea and in the bronchi, in lung sacs of infants, in frogs, in salamander, etc.—Striated fibre to various regions for motion.

Striae not limited to Voluntary Muscle.

Found in heart, pharynx, oesophagus (upper part), internal ear, urethra.

Mode of growth. Increase in bulk of fibre, not in number.

Properties of Voluntary Muscle.

1. Irritability

By virtue of which, contraction when stimulated.

2. Tonicity.

By virtue of which, constant tendency to contract.

3. Elasticity.

May be stretched, and will return to original shape.

4. Extensibility.

Will stretch when weighted—limited.

Nature of contraction.

In waves—tetanic—rapid and sudden, reaching maximum instantly—Relaxation is slow.

VI. DIGESTION.

Food Stuffs.

Group I. Nitrogenized group, Proteids.
E. g. albumen, (white of eggs), gluten, (flour), fibrin (of blood), syntonin, (lean meat), casein, (cheese), etc.

Group II. Carbo-Hydrates, Amyloids.
E. g. starch, sugar, gum, dextrine, etc.

Group III. Hydro-Carbons.
E. g. fats, oils.

Group IV. Minerals.
E. g. salts, water, oxygen. (?)

General Anatomy of Alimentary Canal and Accessories.

Mouth—Pharynx—Oesophagus—Stomach, cardia, pylorus—Intestines, duodenum, jejunum, (valvulae conniventes), Ileum, caecum, (ileo-caecal valve, appendix vermiformis), Colon, (ascending, transverse, descending), Sigmoid flexure, rectum.

1. Position, 2. Length, 3. Attachment, 4. Coats, 5. Vessels, 6. Nerves, of each portion.

Omentum and its reflections—Mesentery and its attachment. Teeth, cf. p. Tongue, cf. Taste, p.

Salivary Glands.

Parotid, Submaxillary, Sublingual, Muciparous—Location, excretory duct and capillaries of each gland—Grape-like clusters of lobules somewhat flattened—Rounded extremities of salivary tube—Lining of "Glandular epithelium"—Characteristic nucleated cells of ducts and their probable function of secretion.

Saliva mingled with food during mastication,–Insalivation.

Regulative mechanism of secretion due to reflex action.
Demonstrated in submaxillary gland, by analogy in other glands.

Unilateral secretion in man, in herbivora, etc.

Composition of Saliva.

Water, epithelium, granular nucleated cells, granular matter, oil globules sulphocyanogen—The least concentrated digestive fluid—Ptyalin, ferment.

Action of Saliva.

Hydrated starch converted into glucose, and into sugar—Sugar converted into lactic acid—Lactic acid acts upon Group I., q. v.—Raw starch un-

changed—Relation of saliva to taste, to deglutition—Mechanical office of saliva—Its quantity—Action of saliva arrested by gastric juice—Waste of saliva by expectoration.

Relative viscidity of Secretions.

Parotid least viscid—Submaxillary more—Sublingual still more—Muciparous most viscid.

Reaction of Saliva Alkaline.

How the glands are excited to activity.

By sight of food—By odor of food—Subjectively—Parotid by movement of jaw—Submaxillary by sense of taste.

Gastric Juice.

Glands—Mucous membrane of stomach, thicker near pylorus, color red at cardiac and middle regions, paler at pyloric—Glandular follicles—Loop of capillary—Simple follicle has cylindrical epithelium, compound has glandular—Peculiar spheroidal cells of middle area, "Pepsin cells"—Follicles—"Peptic glands," not found in pyloric portion—Pepsin, "Unorganized ferment," antiseptic, not diminished by action, necessity of presence of free acid, non-accumulation of—Influence of temperature—Mode of secretion, cf. below.

Action of Gastric Juice.

Pepsin dissolves Group I.—Stages, 1.° Swelling due to acid; 2.° Soluble "albuminose;" 3.° Diffusible stage.

Reaction of Gastric Juice Acid.

Peptic digestion essentially acid.
Lactic acid, hydric chloride.

Empty Stomach has neutral reaction.

Effect of presence of Food in Stomach.

1. Increased vascularity, 2. Slight elevation of temperature, 3. Exudation of acid secretion, 4. Peristaltic movement.

Influence of nervous condition over gastric secretion.

Pancreatic Juice.

Gland, position, size, lobulated structure, excretory duct—Composition—Secretion intermittent.

Action of Pancreatic Juice.

Essentially an alkaline digestion.

1.° Transforms starch into sugar, even when raw, Group II.
2.° Emulsifies fats, Group III.
3.° Dissolves coagulated albuminous matter, Group I.

How the secretion is effected.

Demonstrated in pancreas, ∴ a type.

1. Outer zone of cell formed at expense of blood.
2. Inner granular zone at expense of outer.
3. Secretion at expense of inner zone.

Two Stages in secretion.

1.° Manufacture of zymogen.
2.° Conversion of zymogen into ferment.

Intestinal Juice.

Glands, Brunner's, limited to duodenum, lobulated structure, lined with glandular epithelium—Follicles of Lieberkühn, whole length of small intestine, lined with cylindrical epithelium.

Action of Intestinal Juice.

1.° Converts hydrated starch into sugar.
2.° Emulsifies fats.

Reaction Alkaline.

Secretions of Large Intestime.

Excretine—Stercorine, transformed cholesterine.

Liver.

Position—Lobes—Attachment—Arteries—Veins—Special character.

1.° Two sources of blood supply—Hepatic artery—Portal vein, no valves.
2.° Large size.
3.° Texture—Glandular cells and capillaries—Hepatic lobules—Interlobular veins—Minute vessels into substance of lobules, Intralobular veins—Biliary ducts lined with pavement epithelium—Plexus of biliary canaliculi—Capillary bile-ducts smaller than capillary blood-vessels and situated at maximum distance from blood-vessels.
4.° Liver, Duct of Spleen—Filter for removal of discs disintegrated in Spleen.

Bile, special character of.

1. No albuminous ingredient.
2. Is dichroic.
3. Is fluorescent, due to biliary salts.
4. Has characteristic spectrum.
5. Color varies—bilirubine oxidized, biliverdine.
6. Secretion constant, most abundant after digestion and absorption have commenced,

7. Not found in color.
8. Not an excrementitious fluid.
9. Re-absorbed in intestine.
10. Bile and gastric juice not incompatible.
11. Bile-pigment, source of faecal pigment.

Action of Bile.

1. Slight emulsifying power.
2. Assists osmosis of fats.
3. Dissolves hydrated starch.
4. Group II. q. v. converted into glycogen, reserve material, which is transformed into sugar.

Glycogen transformed into glucose enters hepatic vein—Formation of glucose constant—Does not accumulate, is absorbed—If glucose is excessive, sugar is eliminated in urine, Diabetes.

How secretion of Bile is effected.

Due to metabolic activity of protoplasm of hepatic cells.

Digestion completed in Lungs.

Fatty matter is transformed in lungs. q. v.

Absorption.

1 Villi. A. Distribution from pylorus to ileo-caecal valve.
Bathed in digested fluid.

B. Form, in duodenum flattened, leaf-like, otherwise cylindrical.

C. Structure, (1) Epithelial layer, (2) Capillaries, origin of mesenteric vein, (3) Central lymphatic–lacteal vessel, its origin is the longitudinal space, it is provided with an elastic coat.
Relation of lymphatics and lacteals—Lymph=blood-red corpuscles—Chyle =lymph + neutral fat.

D. Action, food is absorbed, (1) through epithelium, (2) to vessels, capillary plexus most superficial,

2. "Peyers patches"—Lymphatic glands, "afferent" and "efferent" vessels.
In birds, in mammals, not in fishes, not in reptiles.

"Lymph globules"—Lymphatic circulation, direction of, how effected, function—Enlargement of lymphatic glands.

Disposition of absorbed food.

Digested food enters circulation via Portal System and via Thoracic Duct —Contraction of villus forces contents into veins and into lymphatic plexus, through mesenteric glands to receptaculum chyli—Regurgitation prevented by valves.

Absorption accelerated by peristaltic movement.

General System of Absorbents.

From periphery by plexuses toward centre—Ultimate discharge of Thoracic Duct and by the Right Lymphatic Duct—Transudation in capillaries—Dialysis—Osmosis—Rapidity of absorption—Hypodermic injections—Valves in larger lymphatics, wanting in reticulated plexuses—Serous cavities = Lymphatic lacunae.

VII. SUGGESTIONS REGARDING FOOD-STUFFS.

I. Quality of food.

Should regard waste.
" " growth.
" " kind of energy demanded—muscle-energy, nerve-energy.
" " production of heat.
" " condition of system.

Infected food not suitable for use.

Argument for mixed diet.

Excreta of adult = 4000 grs. Carbon to 300 grs. Nitrogen, or 13 to 1.
Diet of whites of eggs = 3½ parts C. to 1 part N.
7547 grs. albumen yield 4000 grs. Carbon.
" " " " 1132 grs. Nitrogen—only 300 grs. needed.
1 lb. lean meat yields 1000 grs. C.—deficit, 3000 grs.
" " " " 300 grs, N.
½ lb. fat " " Carbon to supply deficit.

Value of diet of milk, eggs, oat-meal, etc.
Parasites are destroyed by *thorough* cooking.
Quality of food-stuffs greatly effected by preparation.

II. Quantity of food.

Should regard demand, present and future.
Students (generally) do not eat enough.
Healthy appetite should be satisfied.

III. Meals.

Be regular at meals. Do not go hungry.
Be cheerful at meals. Do not retire hungry.
Be hearty at meals.

VIII. BEVERAGES AND NEUROTICS.

Importance of water in animal economy.

Thirst, normal, abnormal—Ship-wrecked sailors.
Temperature of beverages.

Impurities in water.

Spring—Mineral—Rain.
Morbid effects of impure water.

Tea and Coffee.

Conclusions of Dr. Böcker, (Researches on the Action of Tea).
Effect upon nervous system, circulation, digestion, (Huxley).
Prevention of waste, (Draper).
Healthful and injurious effects, (Parkes).

Alcohol as a stimulant.

Per cent of Alcohol in drinks, (Brande).

Small beer	1.2	Malmsey Madeira	16.4
Porter	5.0	Claret	12.–17.5
Cider	5.10	Cape Madeira	20.5
Rhenish	9.0	Sherry	19.2
Hock	9.9	Madeira	22.2–24.2
Elderwine	10.0	Port	23 5
Tokay	10.0	Brandy	53.0
Orange wine	11.2	Rum	53.0
Gooseberry wine	12.0	Scotch Whiskey	54.0
Champagne	12.5	Irish Whiskey	54.0
Burgundy	14.5		

Physiological objections to a habitual use in even small quantities. Poisonous character—Tendency to produce morbid conditions—Prevalence of chronic diseases among those addicted to use of strong drinks—Increased liability to contagious diseases—Diminished endurance for prolonged labor.

Tobacco as a Sedative.

Influence upon vocal organs, upon circulation (Decaisne)—Effects upon stomach, heart, brain, mucous membrane of mouth, bronchial surface of lungs, etc. (Richardson).

Opium as a Narcotic.

Exaltation—Subsequent depression, (De Quincey).

Interchangeable nature of stimulants, sedatives and narcotics.

IX. DEVELOPMENT OF ALIMENTARY CANAL.

A. Groove open toward yolk-cavity of ovum.
Internal layer in which groove is formed = walls of vitelline sac.

B. Groove closed at either extremity, open in middle.
Alimentary canal = straight cylinder, closed at ends, in front of vertebral column—Extremities of canal attached to vertebral column directly, middle region of canal attached by membrane = mesentery —Canal extends from anus to brain.

C. Groove becomes vitelline duct, which is subsequently obliterated—Vitelline sac becomes umbilical vescicle—Umbilical vescicle joined to embryo by pedicle, which is finally atrophied.

D. Increased length of alimentary canal forms loop in middle of body. Middle region of loop dilates = Stomach–longitudinally disposed—Loop connected with yolk sac by vitelline duct—Anterior extremity of duct = pharynx and oesophagus—Mouth = invagination of outer surface of embryo and is at first separated from pharynx by membrane —Anus = invagination of outer surface in similar manner.

E. Right border of stomach enlarged first—Left border receives greater dilation.
First position of stomach median, then oblique, finally transverse, Pylorus seen at 3° month.

F. Protrusion of caecum below apex of loop, cf. 4° stage.

G. Jejunum, at first in umbilical cord, retires into abdomen after 10° week.

H. Colon primarily of less calibre than small intestine.
First appearance entirely at left of small intestine, at 10° week has crossed to right side adjoining liver.

I. Caecum develops back (down) into right iliac region—Completed at 4° or 5° month.
Caecum primarily uniform—Anterior portion grows, posterior region persists = appendix vermiformis.

J. Ileo-caecal valve appears at 3° month.
No appendix at this time.

K. Villous processes primarily throughout canal—Persist only in middle region = "Conniventes."

X. CIRCULATION.

I. Heart.

Position. Relation. Shape. Size. Pericardium. Divisions.

Auricles.

Structure of walls—Muscular columns—Openings—Valves.
Eustachian, Coronary.

Ventricles.

Right, left—Walls.

Structure, relative thickness.

Columnae Carneae—Chordae Tendinae—Openings—Valves.

Tricuspid, mitral, semilunar. Peculiar construction of semilunar of pulmonary artery, and of tricuspid, making slight reflux of blood possible under pressure. Relative length of ventricles during systole.

Pulsations.

Spiral motion of heart during pulsations.

Two sounds of heart, relative intervals.

Rhythmic action.

Auricles act together, ventricles together.

Movement of foot when "Popliteal Artery" rests on knee—Form of pulse.

Direction of Blood through Heart.

Cause of Contraction of Heart.

Due to muscular irritability.

Not due to nervous influence.

Woorara destroys nervous irritability, Potassic Cyanide destroys muscular irritability.

Influence of Nervous System upon Action of Heart.

Blow upon epigastrium produces arrest.

Sudden emotions modify action.

Form and frequency of pulsations regulated by Sympathetic, Pneumogastric and "Vertebral" (?) nerves.

II. Arteries.

1. Coats—(1.) External, connective tissue, dense, strong.
   (2.) Middle, elastic tissue and unstriped muscular fibre.
      (a.) In small arteries, exclusively muscular.
      (b.) In medium, muscular and elastic.
      (c.) In largest, exclusively elastic tissue.
   (3.) Internal, serous, smooth, lined with flattened epithelium,
2. Valves wanting, except semilunars of aorta, and pulmonary.
3. Plan of distribution—Origin = large trunks, Termination = capillaries.
   Peculiar arrangement in fingers, palm of hand, olecranon, knee, toe, parts of sole of foot.
4. Variation in calibre during day.
5. Sphygmograph Tracings.
6. Items to be noted concerning the principal arteries—Name. Origin. Distribution. Principal branches.

III. Veins.

1. Coats—(1.) External, cellular, dense, firm.
   (2.) Middle, fibrous, great resistance to pressure, very thin.
   (3.) Internal, serous, (folds).
   Muscular and elastic tissue less than in arteries, connective tissue more abundant.
2. Frequent anastomoses.
3. Valves—(a.) Distribution.
   In minutest venules, in upper extremity where they do not resist gravity, not in cavities not subject to compression.
   (b.) Bordered by fibrous ring.
   Veins not distended at valves.
   (c.) Function.
   To arrest reflux, when blood resists gravity.
   " " " " " under pressure.
   " " " " muscular contraction forces blood to skin.
   To prevent excessive strain upon peripheral veins.
4. Movement of blood through veins due to
   (a.) Pressure from capillary system.
   (b.) Contraction of voluntary muscles.
   (c.) Force of aspiration.
5. Capacity of veins—double that of arteries.

IV. Capillaries.

1. Distinctive structure.
   Single amorphous tunic, longitudinal nuclei, flattened epithelial cells, small uniform diameter.
2. Plan of distribution.
   Frequent inosculations, characteristic arrangement in muscles, in mucous membranes, in papillae, in malpighian bodies, in connective tissue.
3. Circulation in.
   Arterial pressure upon blood in capillaries, uniformity of current influenced by elasticity of adjacent tissue, subject to local variations, e. g. pallor, "blushing," congestion, inflammation, condition of glands in action, etc.
4. Relation to tissue.
   Indirect contact with substance of tissue—Intervascular spaces nourished by transudation and absorption of fluid, cf. Lymphatics. p.

V. Rapidity of Circulation.

Circulation completed in 23 sec. or 20 sec.

All blood of body through heart in 48 sec.

If pulsations increased, general circulation increased, but not in same ratio.

Not uniform throughout body, e. g.

In carotid from 4.5 in.—8 in. per sec., in metatarsal 2.2 in. per sec.

VI. Forces of Circulation.

Contraction of Heart.
Elasticity of Arteries.
Capillary Attraction.
Muscular Pressure.
Partial Vacuum in Lungs.
Chemical Affinity.

VII. Circulation affected by.

Clothing.
Cleanliness.
Exercise.
State of Mind.
Quantity of Blood.
Quality of Blood. cf. Respiration, p.
Temperature. cf. Animal Heat, p.

XI. FOETAL DEVELOPMENT OF HEART.

1. Longitudinal Tube.—Two vessels entering same = veins.
Union of veins = Primitive Auricle.
Dilation of tube = Primitive ventricle.
Anterior portion of tube = Primitive Bulb.

2. Slight dilation of Auricles.—Two appendages = True Auricles.
Increased thickness and length of ventricle—Flexion to right.

3. Division of Ventricle and of Bulb by Septa.

V–Septum begun at 4°–5° week—completed at 8° week. Auricular Septum begun at completion of V–Septum, (foramen ovale), completed at birth—cyanosis.

4. Primitive Aortic Arches, right and Left from Bulb.

Primitive dorsal aortas, right and left.
Omphalo-mesenteric arteries.

5. Union of two dorsal vessels behind (dorsal to) Heart.

6. Formation of secondary Aortic Arches.

These join ventral and dorsal trunks, from anterior to posterior in succession—Five pairs—Do not co-exist.

7. Transformation of Temporary into Permanent Arterial Vessels. Ascending aorta persists from Primitive Bulb, 7°–8° week.
Ventral trunks = external carotids—Dorsal trunks = internal carotids.
Formation of descending aorta from united dorsal trunks. q. v.
Formation of "arch" from left 4° primary aortic arch.
Formation of Pulmonary arteries from branches of left 5°.
Formation of Ductus Arteriosus from left 5° aortic arch.

8. Oblique position of Apex at 4° month.

XII. PLAN OF FOETAL CIRCULATION.

Allantois—Mucous membrane of uterus—Penetration of villi of allantois into mucous membrane—Modification of maternal capillaries, complete fusion into sinuses—Foetal capillary tufts bathed in contents of sinuses, cf. absorption—No direct communication between foetal and maternal vessels—Osmosis of nutriment in sinuses—Placenta = Organ of exhalation and absorption—General direction of circulation.

1. From placenta through umbilical vein to liver.
   (a.) Through ductus venosus to ascending vena cava.
   (b.) Through liver, via hepatic vein to vena cava.
2. From vena cara to right auricle and through foramen ovale into left auricle—Action of eustachian valve.
3. Return from head and upper extremities through descending vena cava to right auricle and into right ventricle.
4. From right ventricle through pulmonary artery, ductus venosus into arch.
5. From left ventricle through system.
6. From iliac via hypogastric to placenta.

XIII. BLOOD.

1. Amount.

$\frac{1}{13}$ weight of body, average 18 lbs.

2. Composition.

A. Plasma, 55 per cent.

Water, albumen, salts, fibrin 3 parts in 1000. (Serum—Clot, action in arresting hemorrhage.

Conveys nutriment to body.

B. Corpuscles, 45 per cent.

Red—1. *Shape* = Circular in all mammalia (except camel and llama = oval).

2. *Size* = $\frac{1}{2777}$ in. — $\frac{1}{4000}$ in. diameter, average $\frac{1}{3224}$ in., thickness = $\frac{1}{5}$–$\frac{1}{4}$ transverse diameter—"Central depression."

In elephant and sloth exceed human, $\frac{1}{2700}$ in., in some mammals, equal human or smaller—musk-deer smallest, $\frac{1}{12000}$ in.—birds' exceed mammals'.

Human not distinguishable from most domestic animals'.

Hemoglobine distinguishable from other coloring matter.

3. *Sexual difference.*—In male more abundant than in female.

4. *Origin.*—Theory of action of spleen = nucleus of white disc(?) —Connective tissue(?)—Division of disc(?)—Metamorphosis of mesoblastic cells = Sanguineous Blastema.

5. *Metamorphosis*—Color pigment of urine—Bile.

6. *Development of*—Colorless, yellow, red (foetus $\frac{1}{10}$ in. long)—After 3° week until 8° week, size = 30–100 per cent. larger than in adult, shape = circular, ovoid, globular—Nearly all nucleated—At 4° month, only few nucleated.

7. *Composition*—Albuminous matter, coloring matter = hemoglobine, its affinity for oxygen.

8. *Structure*—Homogeneous (Dalton) — External membranous sac = envelope, and internal viscid fluid, (Kölliker, etc.)

9. *Relative number*—Before and after meals.

White : red : : 1 : 330, : : 1 : 335, : : 1 : 500.

10. *Function*—Convey oxygen to system.

Great absorbing power.

Remove impurities—Respiratory organs of cells—CO_2 causes to swell, O to contract. (?)

Colorless corpuscles—1. *Shape* = Globular, irregular—Amoeboid movements.

2. *Size* = Larger than red, $\frac{1}{2500}$ in.

3. *Origin* = Sanguineous Blastema.

XIV. RESPIRATION.

Structure of Lungs.

1. Divisions—Right, left, relative size, lobes.

2. Pleura—Its reflections—Pleurisy.

3. Capacity—Residual air, supplemental, complemental, tidal—Relative amount exchanged at each respiration—Extreme breathing capacity not increased by habit or practice (Flint).

4. Air vescicles—Location—Size $\frac{1}{60} - \frac{1}{200}$ in.—Convoluted structure—"Ultimate bronchial tubes," lining of pavement epithelium—"Pulmonary lobule," elastic walls—Capillary plexuses.

Bronchi.

Origin—Branches, angle of divergence, sub-divisions.
Relative danger of injury from foreign bodies.
Structure, cartilaginous rings elastic, ciliated, outward vibrations of cilia.

Mechanism of Respiration.

Movements of chest—Extremities of ribs raised by contraction of external intercostal muscles, depressed by internal—Auxiliary action of abdominal and pectoral muscles—Movements of diaphragm, *depressed* by "Diaphragm Pillars," *elevated* (a.) by atmospheric pressure to fill vacuum due to contraction of lung tissue, (b.) by upward pressure of abdominal viscera due to action of abdominal muscles—Expansion of lungs accelerated by vacuum in pleural sac.

Three Types of Respiration.

1. Abdominal, exclusive in children under three years.
2. Inferior Costal = from 7° rib downward, predominates in male.
3. Superior Costal = from 7° rib upward, predominates in female.

Stages of Respiration.

1. Mechanical, atmospheric pressure.
2. Simple diffusion of air.
3. Osmosis = diffusion through cell tissue.

Frequency of Respiratory Movements.

Average 20 per minute, min. = 9, max. = 44.
Modified by age, condition of system, sex.

Expired and Inspired Air.

Expired—Temperature 90°–100° F.—Saturated with moisture—Carbonic acid—Nitrogen—Oxygen—Animal matter.
Sexual difference in amount of carbonic acid.
Inspired—Temperature variable—Moisture variable—Oxygen inspired exceeds amount expired—Nitrogen inspired equals amount expired, temporary variations.

Chemical changes attending Respiration.

Action of oxygen upon Hematin crystals.
" " " " tissues of body.
" " " " fatty matter of food.

XV. VENTILATION.

Conditions sought.

1. Removal of impure air.
2. Abundant supply of fresh air.
3. Suitable temperature.

Items to be considered.

Heated air allowed to escape from floor—Specific gravity of heated air—Impurities not due to temperature—"Ground-air," its relation to ventilation—Sewage—Drainage—Ventilation of cellars—Epidemics—Removal of excreta, etc.

Warming by Radiation and by Heated Air.

Steam-radiators—Hot-air furnaces—Stoves—Quality of air, dust, poisonous gases, moisture, etc.—Quantity of air accessible to heated surface—Economy and convenience of the respective methods.

Construction of Apparatus for Ventilation.

Rooms alternately occupied, and vacant—Study rooms, recitation rooms—Simple methods of making windows available.

XVI. ANIMAL HEAT.

Origin and Nature of.

Common to all living organisms—Increase of temperature from exterior to central parts—Diurnal variation—Chemical action in capillaries—Disintegration—Other causes than production of carbonic acid.

In substance of muscles, in glandular organs.

How rendered constant.

Relation of respiration to animal heat.

Warm-blooded, cold-blooded.

Hibernation related to animal heat—Phenomena of evaporation—Insensible transpiration—Oven girls, Turkish bath—Effect of slight change in temperature of body—Vaso-motor system of nerves.

Modifying Conditions.

Nature of food—Age—Exercise—Condition of brain and nervous system—Condition of skin, q.v. p. —Clothing as it effects radiation, etc.—General health.

XVII. SKIN.

Epidermis.

External layer = Horny layer = exudation from adjacent parts.

No blood vessels—no nerves—no lymphatics—exclusively cells—not transformed "rete mucosum."

Internal layer = "rete mucosum" = malpighian layer—Mucous, nucleated cells—Pigment.

Callous epidermis = corn.

Dermis.

Superficial = Papillary layer (structure of papilla, cf. touch, p.)

Smallest papillae upon face—largest on palm of hand, sole of foot—lines on palm of hand = grooves between compound papillae.

Deep = Reticulated or fibrous layer—Interlacing, elastic fibre—Non-striated muscle.

More abundant near "sebaceous glands, q. v.—contractions produce goose flesh.

Appendages.

Nails—Root—Border—Free edge—Lunula, slight vascularity of subjacent structure—Layers nearly same as epidermis—Development in embryo—Mode of growth, malpighian layer stationary, horny layer grows.

Hairs—General distribution—Characteristic direction upon surface—Hair follicle = Inversion of corium—Its three membranes.

External = inelastic fibre, blood vessels, nerves—Middle = transverse nucleated fibre—Internal = structureless.

Parts of hair, external = imbricated cells—Roughness of surface.

Internal = longitudinal fibres—These contain pigment and few air globules.

Medulla traceable nearly entire length—Nucleated rounded cells, pigment, numerous air globules.

Elasticity—General shape oval.

Straight hair = round, curled = flat.

Growth by imbibition from papillae—Color due to pigment.

Sudden blanching.

Pigment not diminished, greater part of medulla filled with air—possible cause.

Sebaceous glands—Distribution—Lubricates skin—Gloss of hair.

Sudoriparous glands—Special development in axilla.

Peculiar excretion, volatile compounds of fatty acids.

Location—Spiral ducts, lining pavement epithelium, orifices in grooves between rows of papillae, always oblique—Secretion = water and soluble salts, no fatty matter—Filtering mechanism—Absorbents, increase of weight from bathing—Medicated baths—Insensible perspiration—Effect of impermeable coating to surface—Active agent probably epithelium of secreting coils.

Congestion of skin attending exercise favors increased activity of glands, hence reduction of temperature and rapid voidance of effete matter = products of disintegrated muscular tissue.

Relative elimination by lungs and by skin—Bathing—Action of soap upon excretions of sebaceous glands—Removal of epithelium—Congestion of unprotected cuticle—Injury when chill accompanies bath—Inflammation resulting from application of heat to chilled extremities = chilblain—Conducting power of different textures—Their relative value as articles of clothing—Influence of color upon absorbent power of fabrics.

General office of Skin.

Protection of subjacent parts.
Preservation of external form of muscles
Graceful outline to body.
Excretion of effete matter.
Regulation of temperature of body.
Absorption.

XVIII. NERVE CELL = GANGLION.

Structure.

Cell-substance, fine granular, albuminous—Nucleus—Nucleolus—Pigment grains.

Size.

Largest in anterior horns of spinal cord.

Prolongations of Cell.

Structure same as cell-substance—Number—Sympathetic and cranial, one or two (generally) = "unipolar" and "bipolar" cells—Gray matter of cerebrum has cells with several = multipolar—Anastomosis of branches from prolongations = Plexuses—One prolongation from "multipolar" cell, peculiar = undivided = "axis cylinder" process.

Distinctive cells of dorsal portion of Spinal Cord.

Not connected with nerve fibre.

"Nerve Centres."

For registering and for transmitting nerve-impulses—Medium for associating organs.

XIX. SPINAL NERVES.

Structure of Nerve.

1. Kinds of tissue—(a.) white = nerve fibre only—(b.) Gray = fibre, interstitial matter, nerve-cells, primitive nerve-fibrils.
2. General character of nerve-fibre—Shape—Arrangement in bundles or tracts—Entirety of fibre, non-inosculation or division—Interchange of fibres from one tract to another—Neurilemma—Neuralgia, etc.—Relative distribution of large and small fibre to cutaneous and to muscular regions—Average size of fibres, variations in different regions of same tract.
3. Histology—External sheath—Medullary layer, its insulating office, its absence at origin, at termination of nerve, and "non-medullated" nerves—Axis-cylinder, its function.

Peripheral termination of Fibre.

1. Formation of "terminal plexuses"—Division of fibre and distribution of ultimate fibrils to anatomical elements of tissue.
2. Correspondence in function of several fibrils to axis-cylinder of undivided fibre.
3. Disappearance of medullary layer and blending of neurilemma with sarcolemma near terminal region of nerve.
4. Persistence of "axis-cylinder."
5. Ultimate structure of "Pacinian Bodies," "Tactile Corpuscles," "Terminal Bulbs."
6. Direction and disposal of terminal fibre in muscles—"Terminal Plates."

Roots of Spinal Nerves.

Dorsal = "Posterior"—Relative size—Bi-lobed ganglion, its uni-polar and bi-polar cells—Non-union of nerve-fibre with cells (mammalia)—Characteristic union of same (pisces)—Enlargement of root by additional fibre from ganglion—Double origin of fibre corresponding to

bi-lobed ganglion—Characteristic location of ganglion—Afferent function of dorsal root—Fibres enter cord between dorsal and lateral columns.

Some enter gray substance, some enter both gray and white, some enter anterior horn of cord.

Ventral = "Anterior"—Absence of ganglion—Collocation of fibre into two bundles—Union of gray matter of "anterior horns" of spinal cord by fibres of ventral root—Function of fibres = efferent.

Union of Roots into Compound Nerve.

Relative length of roots, consequent direction—Connection of filaments with sympathetic system—Hygienic considerations.

Union of Nerves into Plexuses.

Cervical—Brachial—Lumbar, etc.

Number of Pairs.

Plan of naming—Special branches and their distribution.

General Properties.

Irritability. exhausted by experiments, destroyed by woorara—Reunion after separation—Paralysis, nervous, muscular—Distinctive direction in which "nerve wave" is propagated in sensitive and in motor nerves—Rate of transmission of energy—Duration of impression after removal of exciting agent—Nature of "nerve wave" same in afferent and in efferent nerves—Action of galvanic current upon nerves.

Function of Spinal Nerves.

General—Special.

XX. SPINAL CORD.

Position—Length.

Embryo—Adult.

General Structure.

Meninges—Columns, ventral, dorsal, lateral—Central canal—Intercommunication of fibre with cells of gray substance, with longitudinal columns—Commissural union of cell with cell.

Special Structure.

Increase of gray matter at cervical and at lumbar enlargements—Graduai decrease of white substance from anterior (upper) region toward posterior (lower) region.

Gray substance—*Structure*—(a.) Nerve cells, multipolar, grouped in "horns,"ventral larger, dorsal smaller.

(b.) Nerve fibres radiate in transverse plane.

1. Fibres from spinal nerves.
2. Commissural fibres, coördinating the halves of cord.
3. Irregular fibres.

Insensibility to artificial stimuli.

Sensitive impressions transmitted through gray matter alone, not through white columns.

White substance—*Structure*—Longitudinal fibres forming "columns," ventral, middle, dorsal—Fibres from ventral column terminate in opposite ventral horn.

Motor impulses transmitted through white and gray of ventral columns, not through either separately.

Function of Cord.

Organ of communication between brain and spinal nerves—Sensibility of dorsal column or fibre from dorsal root of spinal nerve to external irritation—Inflammation of meninges—Excitability of ventral columns, attended by motion of parts and absence of pain—Ventral section of lateral column acts with ventral column, dorsal with dorsal column.

Bi-lateral decussation of Motor Fibre in Medulla.

Effect of injury to brain—Injury to cord below medulla—Longitudinal division of spinal cord, of medulla.

Bi-lateral decussation of Sensitive Fibre throughout Cord.

Transverse section of lateral half of cord paralyzes motion of same side and enfeebles sensibility of opposite side—Local hyperæsthesia.

Relative seriousness of injury to Cord.

In lumbar and in cervical regions—Paraplegia, Hemiplegia, total and partial.

Reflex Action.

Irritability of cord increased by strychnine, by injury to peripheral nerves —Tetanus—Importance of reflex action in self-preservation in regard to equilibrium and locomotion, in controlling sphincter muscles, etc.

XXI. SYMPATHETIC SYSTEM.

Structure.

Anatomical elements same as spinal nerves q.v.—Cells, small, numerous, joined by nerve filaments.

Relation to Posterior Roots of Spinal Cord.

Influence upon cerebro-spinal system—Homology of ganglion of sensitive root with sympathetic ganglion.

General Properties.

Noticeable interval between application of stimulus and responsive action of nerve—Congestion not immediate.

Distribution.

Double chain in front of spinal cord—To glands—To mucous membrane —To involuntary muscle, etc.—Classification of special ganglia with reference to head, neck, chest, abdomen, etc.

Distinctive Function.

Relation to nutrition, secretion, vaso-motor system—Experiments with guinea pigs—Connection with special senses, sight, hearing—Reflex action.

Internal irritation, e. g. nausea, etc.—external irritation, e. g. fright, etc.—mutual influence of organs, e. g. peristaltic movements.

XXII. BRAIN.

Location—Enveloping Membranes.

1. Dura Mater—Structure of its two layers—Outer and inner surfaces—Adherence to cranial bones—Periosteum of cranial bones—Internal sinuses—Its reflections and corresponding chambers formed, falx cerebri, falx cerebelli, tentorium.
2. Arachnoid—Extent and character of parietal and of visceral layers—Arachnoidean spaces, their intercommunication—Cerebro-spinal fluid, its function—Equilibrium of pressure upon surface of brain.
3. Pia Mater—Extent—Vascular structure—Vessels—Lymphatics–Nerves Reflections in sulci of brain.

Structure of Brain.

1. Exterior surface—Kind of neurine—Gray substance penetrated by white fibre—Nerve-cells, their forms and elongations—Convolutions—Fissural pattern, *three principal* = (a.) Fissure of Sylvius, always present if any, (b.) Fissure of Rolando, (c.) Parietal fissure; *secondary* = (a.) three frontal, (b.) two central, (c.) three temporal—Superficial indentations for vascular system.
2. Interior of brain—Cerebral ganglia—Ventricles—Commissures—Membranes—White nerve substance—Nerve fibres $\frac{1}{10000}$ in.–$\frac{1}{2000}$ in. in diameter.

XXIII. DIVISIONS OF BRAIN.

Cerebrum.

Position—Hemispheres—Longitudinal fissure, cf. dorsal median fissure of spinal cord—Corpus Callosum, extent, structure = transverse commissure between cerebral hemispheres—Lateral ventricles, boundaries, shape, termini of anterior, middle, and posterior cornua—Septum lucidum, 5° ventricle, its isolation in adult—Corpus striatum, its position, arrangement of fibre in bundles—Anterior cerebral commissure—Choroid plexus—Hippocampi.

Optic Thalami.

Position in hemispheres—Intimate mixture of fibres with gray matter—Optic tracts—Corpora geniculata—3° ventricle, its boundaries—Foramen of Monro—Velum interpositum—Iter to 4° ventricle—Pineal and Pituitary bodies.

Cf. Sheep, shark, lophius, etc.

Corpora albicantia—Middle cerebral commissure—Posterior commissure.

Corpora Striata and Optic Thalami, Nerve Centres between Medulla and Hemispheres.

Forced movements from injury to C. S., rotation of body, somersaults, pleurothotonos—Spasmodic action of face and neck—Flexors rather than extensors stimulated—Transmission of efferent impulses through C. S. = motor centre—Transmission of afferent impulses through Op. Th. = sensory centre—Each affect the opposite side of the body = crossed action.

Corpora Quadrigemina.

C. Bigemina = optic lobes—Position—Distinctive structure—Peduncles of cerebellum—Valve of Vieussens—Iter, etc.—*Anterior tubercles* produce rigid backward flexure of body, opisthotonos, jaws clenched, pupils dilated—Motor centre for extensor muscles—Coördinate movements of eyeballs and pupils—Register visual sensory impulses—*Posterior tubercles*, production of various noises—Motor action not confined to either side of body.

General Physiological Action of Cerebral Hemispheres.

Homology of anterior lobes and anterior middle lobes of cerebrum with entire cerebrum of other mammals—Posterior lobes, centres of cerebration peculiar to man—Coördinate and direct, do not originate muscular contractions—Experiments of Ferrier—Limited action, principally crossed, not diffused action—Hemispheres not directly essential to life, argument from pathology, from experiment—General function of conscious intelligence, memory, reason, judgment—Congenital idiocy from imperfect cerebral development—Aphasia, from lesion in region of island of Reil, from posterior frontal convolution (Broca)—Distinction between machinery for execution and machinery of origination.

Brainless frog executes movements like entire frog except difference in stimuli required.

"Afferent impulses equally essential with efferent in complex bodily movements."

Stages of reflex action, afferent, central, efferent.

Experiments of Hitzig and Fritsch on cerebral convolutions—"Cerebral spots not motor centres"—Does the escape of current to deeper underlying portions, corpora striata, produce the phenomena cited?

Cerebral convolutions functionally psychical—Posterior parts, corpora quadrigemina, crura cerebri, pons Varolii, cerebellum and medulla execute complex movements—Rapidity of cerebral operations, winking, auditory and visual sensations, etc.

Crura Cerebri and Pons Varolii.

Communication between spinal cord and cerebral hemispheres—Mechanism of coördinated movements referred to pons and to semicircular canals of ear, cf. p.

Tuber Annulare.

Nervous centre, registers sensations of pain—Reflex actions of emotional and instinctive character—Seat of sense of equilibrium in posture of body. (?)

Cerebellum.

Bridge over 4° ventricle—Connection with cerebro-spinal axis through anterior, middle, and posterior peduncles.

Cf. Corpora dentata, cerebral ganglia and olivary nuclei.

Explanation of automatic movements begun under direction of will—Reflex-action a character—Coördination of movements—Relation to semicircular canals in maintaining equilibrium—Experiments of Ferrier and Hitzig—No relation to sexual functions.

Medulla Oblongata.

Characteristic arrangement of fibre—Decussation of pyramids—Deposits of gray substance, increase in quantity anteriorly—Origin of cranial nerves except 1° and 2° pairs—Olivary nuclei—A nerve centre.

Respiratory centre—Vaso-motor centre—Cardio-inhibitory centre—Diabetic centre—Deglutition centre—Nausea centre—Saliva-secretion centre—Pupil-dilating centre—Phonation and Articulation centre, (Foster).

XXIV. DEVELOPMENT OF THE BRAIN.

Formation of Vescicles.

1° Stage. Brain = Anterior portion of medullary tube.

2° Stage. Expanded walls = three primary vescicles.
Anterior, middle, posterior.

3° Stage. Anterior vescicle bent downward, middle conspicuous.

4° Stage. At 7° week angle projecting dorsally between 3° vescicle and spinal cord = cervical tuberosity.

5° Stage. Angle projecting ventrally between medulla and cerebellum.

6° Stage. Depression in middle vescicle = corpora bigemina.

7° Stage. Flexion of first primary vescicle at right angles.

Sub-Division of Vescicles.

Division of anterior vescicle into:

Anterior part = Prosencephalon = Cerebrum.

Posterior part = Diencephalon = Thalami.

Middle vescicle = Mesencephalon = Optic lobes.

Posterior vescicle, bridge over medulla = Epencephalon = Cerebellum.

Triangular depression = Metencephalon = Medulla and 4° ventricle.

Rapid development of Anterior Primary Vescicle upward and backward.

Differentiation of Vescicles.

Posterior Vescicle—Constituent parts of medulla distinguishable.

(a.) Restiform bodies at 3° month.

(b.) Anterior pyramids at 5° month.

(c.) Olivary bodies at 6° month.

Delicate membrane above and across medulla at 3° month = cerebellum.

Junction of fibres of cerebellum with pyramids = pons varolii.

Middle Vescicle—Optic lobes defined by median groove at 4° month—Persistence of primary tube connecting vescicles = "iter, etc."—Valve of Vieussens—Optic lobes differentiated in upper region, sides and roof, as anterior and posterior at 7° month—Crura cerebri developed from below = floor.

Anterior Vescicle—Appearance of two lateral outgrowths = Thalami Optici—Development of thalami, optic nerve, optic tract—Sides of anterior vescicle = Cerebral Hemispheres—Floor of vescicle = Corpora Striata—Anterior commissure—Development of pineal body from vescicle, (?) from pia mater, (?) at 4° month—Pituitary body from "Chorda dorsalis," (?) from pia mater (?) from alimentary canal—Filling of vescicle posteriorly, ventrally and laterally, 3° month—Persistence of 3° ventricle—Posterior commissure—Chambers enclosed by two lamellae in cerebral hemisphere = lateral ventricles, 4° month—Appearance of convolutions and sulci at 4° month—Separation of anterior and middle lobes of cerebrum by fissure of Sylvius, 4° month—Appearance of fissure of Rolando—Narrow fibrous band across anterior region of hemispheres at 3° month = Corpus Callosum—Septum lucidum and 5° ventricle—Development of olfactory lobes from anterior part of cerebral vescicle. (?)

XXV. CRANIAL NERVES.

General Character.

Common origin (ex. 1° and 2°) = gray matter upon and beneath floor of 4° ventricle = continuation of spinal cord.

Trigemini has two roots, (a.) sensitive, (b.) motor.

Glossopharyngeal receives fibres from facial.

Pneumogastric receives fibres from spinal accessory.

3°, 4° and 6° = branches of single nerve, cf. branches of 5°.

6° and 7° = branches of 5° in Rana pipiens.

Homologized as spinal nerves—Correspondence of structure and arrangement with spinal nerves when correspondence in function—Plan of nomenclature.

XXVI. NERVES OF SPECIAL SENSE.

General Character.

Not sensitive—Not excitable—No sensation of pain or of touch when irritated—Section does not affect sensibility of neighboring regions—Tracts or commissures rather than nerves proper.

Olfactory = 1° pr.

Anatomical relations—Limited distribution—Relative development in other animals—Effect of destroying it—Origin = three-cornered prismatic tract, whose terminus = "Olfactory bulb."

Cf. trigon, shark, sheep, rabbit, etc.

Distribution of terminal fibres—Schneiderian membrane, cf. sense of smell, p.

Unification of the two bulbs through white fibre of tubercles—Singleness of function.

Optic = 2° p'r.

Nerve tract from organ of vision to cerebrum—Not sensitive—Relation to movements of iris—Reflex action—Conducts one kind of impression—Chiasma—Decussation of fibre, relation to bi-nocular vision.

Cf. shark, cod, pigeon.

Partial blindness from "Hemiplegia"—Origin threefold, corpora geniculata and adjoining region of optic thalami—Distribution—Apparatus of Retina, v. "sight," p.

Auditory = 8° p'r.

Origin—Auditory ganglion on floor of 4° ventricle—Distribution—Internal ear, v. "hearing," p.

XXVII. NERVES OF MOTION.

Oculo-Motorius = 3° p'r.

Connection between both eyes established through decussation of fibres from nuclei—Effect of paralysis of 3° p'r—"Strabismus"—"Ptosis."

Origin—Gray cells common to 4° p'r behind optic thalami—Distribution, muscles of eye, ex. external rectus and superior oblique—Function, controls motions of eye, ex. lateral abduction and rotation.

Patheticus = 4° p'r.

Origin, with 3° p'r—Distribution, superior oblique of eye—Function, to preserve parallelism of eye-balls in horizontal plane, to prevent double vision.

Abducens = 6° p'r.

Origin, Gray matter on floor of 4° ventricle—Distribution, external rectus of eye—Function, controls outward movement of ball.

Internal strabismus from paralysis of 6° p'r.

Facial = 7° p'r.

General facial expression due to stimulus of 7° p'r—Paralysis of 7°, eye permanently open, tears not distributed, smoothness of forehead, distorted nostril, lip, etc.—May affect same side of face, or opposite side because of crossed action of nerve—Origin, common with abducens—Distribution, muscles of face, as above—Function, strictly = motor, fibre from 5° p'r render it in part a sensitive nerve.

Hypoglossal = 12° p'r.

Origin medulla, near olivary bodies—Distribution, muscles of tongue—Action in articulation, mastication, deglutition.

XXVIII. NERVES OF COMMON SENSATION.

Trigemini = 5° p'r.

Acute sensibility to mechanical irritation—Special advantages from peculiar anastomosis of branches of 5°—Influence over special senses, by affecting nutrition of parts.

E. g. Schneiderian membrane, Cornea, Iris, Mucous membrane of mouth.

Neuralgic affections of head, teeth, "tic douloureux"—Profuse secretion of tears attending irritation of cheek, pungent odors, etc.—Compensating influence when facing the wind—Detection of physical qualities of food, consistency, etc., taste (?) by lingual branch = "Gustatory nerve"—Relation to mastication—Effect of partial paralysis of 5° in carnivora, herbivora, rodentia—Origin, tuber annulare from nucleus of 5°,by two roots, (a.) sensitive root, which receives fibres from "Gasserian ganglion" (b.) motor root, no additional fibres—Distribution, three branches, 1. Ophthalmic—2. Superior maxillary—3. Inferior maxillary.

Glosso-pharyngeal = 9° p'r.

Anatomically and functionally a spinal sensitive nerve.

Cf. "petrosal ganglion" with ganglion of spinal nerve.

Tactile sensibility slight—Special sensibility acute = taste, cf. lingual branch of 5°—Reflex action in deglutition—Artificial irritation excites nausea.

Immediate action in absence of emetics.

Origin, common nucleus of 9°, 10° and 11°, on floor of 4° ventricle—Distribution, posterior third of tongue, pharynx, etc.

XXIX. MIXED NERVES.

Pneumogastric = 9° p'r.

Allied to spinal nerves by "Jugular ganglion"—Plexuses formed in thoracic region—Their relation to respiration, circulation, deglutition, voice—Effect of dividing 10°—Phenomena of "arrest"—Origin, ten to fifteen filaments from nucleus, cf 9°—Distribution.

1. Pharyngeal branch. 2. Superior laryngeal. 3. Inferior laryngeal. 4. Oesophageal. 5. Pulmonary. 6. Gastric.

Function, primarily sensitive—Compound structure renders it "mixed"—Protection against foreign substances in the several regions—Sympathetic action of lungs and stomach.

Spinal Accessory = 11° p'r.

Relation to muscles of phonation—Distribution of fibre to pneumogastric, to cervical muscles—Paralysis of 11° does not destroy respiration.

XXX. SENSE OF TOUCH.

Modes of distribution of Nerve Fibre.

Terminal plexuses—Sensory organs, 1. Terminal bulbs, 2. Tactile corpuscles, 3. Pacinian bodies.

General structure—Central granular layer, Capsule of connective tissue, Pale nerve fibre, which terminates in core.

Special structure—1. Terminal bulbs.

Spheroidal—nerve fibre ends in knot—capsule simple—taste bulbs—terminal bulbs of conjunctiva, lips, tongue, etc.

2. Tactile corpuscles.

Oval—oblong nuclei of capsule transverse to axis—nerve fibre surrounds core in serpentine windings, and terminates in pale fibre—most abundant on last phalanges of fingers, less in palm of hand, sole of foot, lips, dorsal region, etc.—relative sensitiveness of different regions of body.

3. Pacinian bodies.

Oval—clustered like grapes—fibre terminates in knot-like body at outer end of core—capsule = ordinary connective tissue.

General Properties etc. of Nerves of Touch.

Disposal of medullary layer and axis-cylinder—Papillæ having tactile corpuscles, devoid of blood vessels—Most papillæ having capillaries, devoid of corpuscles—Office of perspiration in relation to touch—Knowledge of form, surface, etc.—Education of tactile nerves in blind—Quality of fabrics and liquids judged by touch—Confusion from crossing fingers, etc.—Views entertained respecting senses of weight, muscular tension, temperature, pain, hunger, thirst, etc.

XXXI. SENSE OF TASTE.

Tongue.

Structure—Attachment—Movements—Papillæ of mucous membrane.

Fungiform, filiform, circumvallate—distribution, distinctive structure, vessels and terminal nerves in each.

Terminal bulbs—Taste buds—Mucous follicles.

Sensibility of tip, edges, and base—Distribution of lingual branch of 5° and of glosso-pharyngeal—Sympathetic action of muscles of face and stomach—General and special sensibility of tip.

Distinction in savor, flavor, pungency, "oily taste," etc.—Relative sensibility of tip to sweet, of base to bitter, etc.

Stages in Taste.

1. Solution—effected by saliva, by movement of tongue producing pressure and friction—2. Endosmosis—3. Contact with nerve filaments.

Taste = combination of general sensibility and special sense.

XXXII. SENSE OF SMELL.

Olfactory Membrane.

Superior and middle turbinated region, upper septum nasi—Characteristic color, yellow (man, sheep, calf); brownish (other mammals)—Structure, soft, succulent—Thickness—Ciliated membrane.

Sense confined to filaments of special nerve = Olfactory.

Nerves of Nasal Passage.

1. Filaments of olfactory nerve. Origin from olfactory bulb—Tract from bulb to cerebrum = prolonged convolution—Olfactory cells—Termi-

nal plexus—Bush-like tufts of fibres—Distribution to olfactory membrane—Communication of olfactory nerves through white substance of tubercle.

Homologue in cat, dog, rabbit, frog, shark, etc.

2. Nasal branch of 5°. Distribution to inferior turbinated region—Sensibility—No power of smell—Pungent "odors."

3. Sympathetic nerves. Posterior nasal passage.

Physiology of Smell.

1. Solution of odoriferous particles by secretion of mucous membrane.

2. Endosmosis and contact with nerve filaments.

Relation of smell and taste—Results of experimental division of olfactory nerve in dogs—Pathological investigations.

XXXIII. SENSE OF HEARING.

1. External Ear.

Cartilage.

Helix, tragus, meatus, aid in determining direction of sonorous impulse.

Hairs—Cerumen—Muscles, comparative development.

2. Middle Ear.

Tympanum.

Structure of three layers—funnel shape—attachment to malleus—how stretched—how relaxed—adaptation to pitch, etc.—tensor tympani—transmission of sonorous impacts to manubrium of malleus.

Ossicles. System of levers—Peculiar articulation of malleus and incus.

Inward motion of malleus necessitates inward motion of incus, outward motion does not.

Rotation of malleus—Pendulum movement of stapes—Function of stapedius muscle—Single or unit movement of ossicles.

Openings. To meatus closed by tympanum—Fenestra ovalis to vestibule, foot of stapes—Fenestra rotunda to cochlea (tympanic stairway) closed by membrane—Eustachian tube to pharynx, open.

Equilibrium in atmospheric pressure.

Mastoid cells.

3. Internal Ear = Labyrinth.

Vestibule. Perilymph—Sacculus, its communication with cochlear duct—Utricle, its communication with semicircular canals—Endolymph—

Peculiar distribution of fibre of auditory nerve—"Macula Auditiva"—"Auditory hairs"—Axis-cylinder, sensitive to sonorous impacts (sacculus), and to variation in pressure (utricle)—Otoconia, otoliths.

(Mammals, Birds, Reptiles, Fishes, some Molluscs, some Articulates).

Semicircular canals. In vertebrates (amphioxus ?), number and relative position constant—Equilibration of movements (?)—Ampullae, absence of nerve-fibre.

Cochlea. In mammals—Modified in birds, scaly reptiles—Absent in naked reptiles and fishes—Analogue in insects = antenna—Modiolus—Spiral lamina—Basilar membrane—Vestibular stairway—Reissner's membrane—Cochlear duct—Tympanic stairway—Organ of Corti.

Outer rods, inner rods, relative inclination, length, shape, arch, cells of Deiters.

Roof membrane—Spiral ganglion—Plexus—Hair cells—Auditory elements.

Physiology of Audition.

Requisites for sound—Analysis of simple wave, of compound wave—Sympathetic vibrations—Octave pitch when vibrating fork held against temporal bone—Action of ossicles on fenestral membrane, on perilymph, endolymph, organ of Corti, etc.—Duration of sensation excited by sonorous impulse—Pendulum motion requisite—Intensity due to amplitude—Pitch to frequency—Limits of audible sound.

XXXIV. SENSE OF SIGHT.

Appendages of Eye.

Eyebrows. Structure—Function in relation to light, dust, etc.

Eyelids. Relative size—Tarsal cartilage and ligaments—How opened and closed—Lacus lachrymalis—Caruncle—Juxtaposition of thickened margins forming triangular conduit to papillæ, outer margin meeting before inner—Insertion and direction of lashes to prevent interlacing—"Plica semilunaris" and its homologues—Meibomian glands—Relative size in lids—Structure and function—Where discharge secretion—Conjunctiva, sensitiveness of, its reflections on globe of eye, corneal peculiar.

Lachrymal apparatus. Glands and ducts—Discharge chiefly in fold above outer canthus—Function of lachrymal fluid—Canals, relative size of upper and lower—Ciliated duct—Termination of nasal duct.

Muscles of eye-ball. Origin, insertion and action of each—Strabismus—Relative tension when at rest—Action during perception and reflection—Tension an aid in determining distance, etc.—Controlling nerves—Paralysis.

Cf. shark, hammerhead, gold fish, etc.

Globe of Eye.

General shape. Profile view gives segments of two spheres, anterior smaller.

Sclerotic coat. Its structure, extent—Outer and inner surfaces compared—Posterior portion thickest—Presence of nerves (?).

Cornea. Relative convexity—Stratified structure—Refractory power, etc.—Absence of blood vessels—Presence of nerves—Relative thickness of centre and margin—Canal of Schlemm.

Choroid coat. Surface, inner, outer—Extent—Folds in anterior margin = ciliary processes—Their attachment to suspensory ligament of lens—Hexagonal nucleated layer of pigment, abundance on ciliary processes and iris—Function—Absence in albinos—Analogous lining of telescopes.

Iris. Position—Structure, sphincter and dilating muscular fibre—Attachment to inner wall of canal of Schlemm—Color pigment of anterior surface and black pigment of posterior, continuous with choroid—Pupil, color, function, size, how regulated.

Hyaloid membrane. Structure, thin, clear—Anterior attachment with "suspensory ligament" of lens—Fibres extend into interior of vitreous humor, in embryo—Not found in adult.

Retina. Extent—Union of anterior margin with ciliary processes—Diminishing thickness anteriorly—"*Macula lutea*," yellow spot—Its position and how found—Depression in retina to one-half its usual thickness—Distinctive structure of yellow spot =

1°. Absence of superficial layer of optic fibre—2°. Abundance of cells of ganglionic layer—Cells superposed.

"Fovea Centralis"= centre of yellow spot.

Retina = two layers, (a.) rods and cones—(b.) nuclear layer—Nucleated fibre directed obliquely outward, instead of perpendicularly to retina—Cones predominate, exclusive at immediate centre—Form of cones elongated.

Ten layers of retina—"*Blind Spot*"—Toward median line from yellow spot—Demonstrated—Predominance of optic fibre—Absence of rods and cones.

Sensitive elements of eye on external layer—"Purkinje's images"—Sensibility of optic fibre to light, experiment of Donders.

Retina not merely expansion of optic nerve—Its anatomical elements give it a distinctive structure—Retina = specialized apparatus connected with terminal nerves of sight.

Humors.

1. Aqueous—Chamber occupied—Slight refractive power—Holds anterior surface of eye in form—Free movement of iris.
2. Vitreous—Consistency—Volume—Refracting power slight—Shape anteriorly—Not supplied with vessels—Nutriment by imbibition from adjacent vascular textures.
3. Crystalline Lens—Capsule—Peculiar form—Retained by humors and hyaloid membrane—Structure, flattened fibres parallel to surface, edge slightly serrated (mammals)—Elements are homogeneous and are united by juxtaposition.

Function.

(a.) To converge rays—(b.) To prevent aberration—(c.) To give distinct perception—(d.) To enable to perceive figure and extension—(e.) To judge of distance. (?)

Cataract—Asymmetrical development of lens.

Vision.

Field of vision in man 150°–180°+.

Cf. birds, fishes, insects.

"Line of direct vision"—Distinctness due to relative sensitiveness to light and to focal adjustment—"Point of distinct vision."

Distant object viewed, and immediately one near at hand, indistinctness until eye adjusted—conscious effort.

Focal Adjustment.

Change in distinctness of image attending adjustment, shown by ophthalmoscope, (Helmholtz).

Far-sightedness = passive state of eye—Near-sightedness = excited state of eye.

Eye at rest adjusted to distant objects—Weariness consequent upon protracted examination of near objects—Far-sight remains intact in the aged—Near-sight is impaired.

Focal adjustment principally accomplished by change of convexity of anterior surface of lens—Experiments of Donders and Helmholtz—"Catoptric Images"—Action of iris and ciliary muscles—Limits of adjustment—Myopia—Emmetropia—Presbyopia—Legitimate and illegitimate use of lenses.

Binocular Vision.

Distance—Form—Position—Perspective—Photographic distortions–Erect vision—"Point of fixation"—Stereoscopic effect—Correspondence of vision in two eyes—Vertigo—Strabismus.

Duration of Luminous Impressions.

Sparks from emery wheel—Spokes of wheel in motion—Thaumatrope—Experiments of Prof. Rood—Retention of image by retina after death. (?)

Exhaustion of Optic Nerve.

Sensibility exhausted—"Complementary colors"—Color-blindness—Temporary and permanent injury from exhaustion of visual nerve.

Luminous effect from Pressure upon Eye.

"Phosphene"—Subjective "stars" resulting from sudden jar, blow, etc.

Color.

Primary, red, green, violet—Secondary, tints.

Suggestions.

Admission of light into counting-rooms, school-rooms, galleries—Decoration of walls, tinting, etc.—Removal of dust from eye—Wearing glasses—Sudden transitions of light avoided—Training of eyes to far sight—Report of Dr. Cohn, of Breslau, upon the eyes of students.

XXXV. MENTAL IMPAIRMENT.

Phases.

Aberration.

Hallucination—Illusion—Delusion.

Emotional Insanity—Mania.

Acute—Chronic.

Monomania.

Homocidal—Suicidal—Kleptomania—Pyromania, etc.

Melancholia—General Paralysis.

Difference in sexes.

Dementia.

Primary—Secondary.

Idiocy.

Congenital.

Imbecility.

Rarely congenital.

Symptoms.

Debilitated attention—Loss of memory—Deviations in facial expression—Faltering in speech—Exaggerations in senses—Vitiated sensations—Peculiar sensations—Unusual conduct—Subjective impressions, etc.

Some of the Causes.

Moral—Physical—Impaired nutriment of cerebral structure—Disturbance in cerebral circulation—Congestion—Anaemia—Vitiated blood—Insomnia—Hereditary transmission, etc.

WORKS CONSULTED.

Allen, Harrison—Outlines of Comparative Anatomy and Medical Zoology: pp. 190. Philadelphia, 1869: Lippincott & Co.

Carpenter, W. B.—Mental Physiology : pp. 737. New York, 1875 : Appleton & Co.

Dalton, J. C.—Human Physiology for Students and Practitioners : Sixth Edition, pp. 825, illus. 316, Philadelphia, 1875 : Lea.

Draper, J. C.—Text-Book on Anatomy, Physiology and Hygiene : pp. 300, illus. 170. New York, 1866 : Harpers.

Flint, Austin, Jr.—Physiology of Man : 5 vols. New York : Appleton & Co.

Foster—Text-Book of Physiology : pp. 570. New York ; MacMillan & Co.

Foster and Langley—Practical Physiology : second edition, pp. 244. London, 1877 : MacMillan.

Gray—Anatomy, Descriptive and Surgical : pp. 876, illus. 462. Philadelphia, 1870 : Lea.

Hawkins, B. Waterhouse—Comparative View of the Animal and Human Frame. London : Chapman & Hall.

Hutchison—Physiology and Hygiene, Text-Book : pp. 270. New York, 1870 : Clark & Maynard.

Huxley—Anatomy of Vertebrated Animals : pp. 431. New York, 1872 : Appleton.

Huxley and Youmans—Physiology and Hygiene : Revised edition, pp. 485. New York, 1876: Appleton.

Küss—Lectures on Physiology : pp. 531, illus. 130. Boston, 1875.

MacDonald—Water Analysis : pp. 65, plates. London, 1875 : Churchill.

Max von PettenKofer—Ground Air in its Hygienic Relations. Popular Science Monthly, July, 1877.

Mayer—Physiology of Audition. American Journal of Science and Arts.

Prescott—Strong Drink, and Tobacco Smoke : pp. 71, illus. 167, steel. New York, 1870 : Wood.

Quain's Anatomy : seventh edition, 2 vols. London, 1867 : Longmans, Green & Co.

Stricker—Manual of Histology : pp. 1106, illus. 431. New York, 1872 : Wm. Wood & Co.

Tyndall—Dust and Disease. Eclectic, May, 1870.

Wells—Long, Short and Weak Sight : third edition, pp. 248. Philadelphia, 1869.

Wilder—What Young People Should Know : pp. 212, illus. 26. Boston : Estes & Lauriat.

Wilder—Intermembral Homologies.

Winslow—Brain and Mind : second Amer. edition, pp. 483. Philadelphia : Lea.

Yeo—On Stimulants. Popular Science Monthly, Supplement, No. I, pp. 12.

Teacher, Do You Take

If you are not a subscriber,
fully, for your own benefit as well as ours.

Fifty reasons why you should take the Bulletin:

FIRST.—You cannot afford to do without it. Every number contains practical hints and helps which are invaluable. A single paragraph may double your wages. The best teachers in the State present in its columns the secrets to their success. For One Dollar a year, you may profit by the experience of thirty thousand instructors.

SECOND.—You want to be classed among progressive teachers. There is no standing still in the school-room. Every year, every term, every day makes you a better teacher or a worse one, according as in it you either reach out for higher aims and improved methods, or become more contented in apathy and ignorance. The Institute comes but once a year, the Association seldom; but the BULLETIN greets you every month, always fresh, helpful, invigorating. If you would get out and keep out of the ruts, take the BULLETIN.

THIRD.—You want to know what is going on in the educational world. What schools are changing teachers? What salaries are paid here and there? What new topics are they discussing at Institutes and Associations, and what do they say about them? What is the Legislature doing about school matters? When is the next examination for State Certificates? What were the questions at the last examination, and how many passed? Who is married and who married her? Who is buried, and who takes his place? What cases in school-law are before the courts, and how they are settled? What is the programme for the next State Association, what is to be seen there, and how much will it cost to go? What new books useful to teachers have come out, what do they amount to, and what do they cost?—Questions like these and hundreds more are answered every month in the BULLETIN.

FOURTH.—In each volume some valuable book appears in the monthly issues. In Volume First we brought out Common School Law for Common School Teachers, now adopted as a text-book wherever the subject is taught. In Volume Second we gave the Regents' Questions from 1866 to 1876, of which more than ten thousand copies in book form have since been sold. In Volume Third we are publishing Civil Government for Common Schools, by Henry C. Northam, whose Institute instruction in this subject has been so valuable and interesting. This feature alone is well worth the subscription.

FIFTH TO FIFTIETH.—For these reasons ask any live teacher who has ever taken the BULLETIN. Then compare what she says with this resolution which we have just cut from the official report of the St. Lawrence County Teachers' Association, held at Potsdam, Dec. 26–28, 1876:—

"The following resolution passed unanimously and was emphasized by a list of eighty-four subscribers:—

Whereas, The spirit of inquiry and investigation rife among us, the decisions of the important problems underlying our school system, and the spread of educational information have made a live educational journal a *necessity* to all teachers who desire to save themselves from the constant, almost inevitable, tendency to narrow, contracted ideas of this work; and

Whereas, The SCHOOL BULLETIN is not only our State journal, but also interesting, attractive, profitable, full of practical methods, inspiring experience, valuable hints and stirring discussions of the great educational questions; therefore,

Resolved, That it is the sentiment of this Association, that every teacher in St. Lawrence County should become a subscriber to the BULLETIN, and having subscribed, should use this important auxiliary to his work, both for individual improvement, and the improvement of the schools of the county."

☞ *SUBSCRIBE NOW FOR THE SCHOOL BULLETIN. Terms, One Dollar a year.*

A NEW BASIS OF PRICES.

SCHOOL BULLETIN PUBLICATIONS.

Illustrated Catalogue of the *Bulletin Publications*, some fifty in number, by mail, post-paid, for two three-cent stamps.

DAVIS, BARDEEN & CO., Publishers, Syracuse, N. Y.