Professor Ernst Meumann.

Teaching from the Child's Point of View

A New Science Created by
Prof. Ernst Meumann

By Dr. P. R. Radosavljevich,
New York University

Apparatus for measuring blood pressure.

THE problems of education underlie all vital problems. The evidence? You will find it in the fact that every revolution in the history of thought was followed by revolutions in the history of education. It is not without reason that we call our science of education "Pedagogy;" for to the Greek *paidagogos* was a man who took care of a child. If pedagogy means a systematic method of bringing the undeveloped mind under the influence of the developed, it is but natural that to the mind of a child this influence represents a human ideal to be attained. In a broader sense, education implies every influence that a mentally strong person can exert on another person. That includes even self-education. But in a narrower sense, education means school education.

Present school education begins and ends with the adult; for the adult teacher works backward on a basis of adult thinking. In other words, the teacher imposes his own ideas upon the school child. For that reason the science of pedagogy in this twentieth century has developed no further than physics or astronomy had developed in the time of Galileo, and that, despite the fact that pedagogy is two thousand years old. What a paradox it is that scientists spend years in closely studying the character and habits of animals and plants, but have as yet lavished no attention, scientifically speaking, on their own children and pupils. Parents devote more time to the cultivation of gardens and to embroidery than to the education of their offspring. Even governments have as yet done practically nothing in endeavoring to ascertain scientifically what are the conditions that are most favorable to the child's physical, mental and moral development, as compared with what governments have done in the development of agriculture along scientific lines.

After centuries of waiting, we at last find a beginning made to establish a new science of experimental pedagogy, a science which instead of following the old *a priori* methods, accepts the surer method of experimentation and acquires more accurate and positive knowledge about pupils—a knowledge both qualitative and quantitative, by means of which we can free ourselves from the tyranny of traditions as to what constitutes an average school child. When that science is developed we shall be better able to understand what basis there is for the pedagogical belief that schools must be respecters of individuality.

The new science of experimental pedagogy approaches all its problems from the standpoint of the school child. As might be supposed the new movement originated in Germany, the land of pedagogy. And the man who has made it possible, the man who gave the first impetus to the movement, is Prof. Ernst Meumann, now in Hamburg.

Meumann the Creator of a New Science.

Experiment is the guiding idea of Meumann in treating educational problems. His pedagogical laboratories in Zürich, Königsberg, Münster, Halle and Leipzig became the *sanctum sanctorum* of all his numerous pupils who would know the educational truth and understand the workings of the child's mind and the scientific character of pedagogical problems. But our chief obligation to him comes from his numerous experimental pedagogical writings. His "Lectures for the Introduction to Experimental Pedagogy" (in 3 vols.) indicate a vigorous progress in the science of education. It is the only book of its kind as yet in print. Here it is shown for the first time to

Pedagogy in this alleged twentieth century is about in the same condition as was astronomy in the time of Galileo. A science is needed to determine individual differences among children. When that science is developed we shall be able to classify, grade and promote pupils scientifically, and not divide them according to ages or sizes or school marks as we now foolishly do. Some day we will have a real science of experimental pedagogy. A beginning has been made by Prof. Ernst Meumann. This article, written by one who has studied under him, sets forth in a simple way the basic principles of that science. Some day when the new pedagogy will have assumed the importance and dignity of botany or chemistry we will find in every large community a clinic where parents and teachers may receive advice on school matters, a bureau which will act as a consulting engineer in educational affairs.—EDITOR.

what extent the method of experimentation has equipped educators with knowledge as to the facts of school children's development and reaction under instruction.

Prof. Meumann does not agree with James, Münsterberg and other well-known psychologists who claim that education has gained little from experimental psychological investigation; he holds that it has gained very much and pleads that pedagogical experimentation is slowly emerging as a field quite distinct from purely experimental psychology because its problems are more complex and are made with practical ends in view. Experimental pedagogy does not try always to reduce all problems to their most elemental form; it is more synthetic, while experimental psychology is more analytic. And then the teacher's aim is not the acquirement of psychology as a critical doctrine, but as an experimental study of his own school questions. Experimental pedagogy deals, therefore, mainly with the school children, including young women and young men. Meumann aims (1) to show that experimental pedagogy enables the individual teacher to be at all times quite clear in his own mind as to the justification of his pedagogical measures, and (2) to impress upon the teachers the necessity of seeking to answer all pedagogical questions from the pupil's standpoint in order to rid themselves of the conception current in older pedagogy that the child is merely an adult on a small scale.

Statistics vs. a Knowledge of the Child Mind.

Although Meumann admits that pedagogical theory has been the chosen field of amateurs and of self-educated persons, he fully recognizes the folly of those

modern experimentalists who pile up statistical masses of apparent facts without, as a preliminary, striving to get a thorough-going analysis, i. e., without a full and clear conception of the psychological units involved. We have to keep in mind that a statistical conclusion is not a psychological interpretation, and that a psychological possibility does not mean necessarily a pedagogical necessity.

Meumann shows that in educational theory as well as in educational practice new fields and standpoints have been acquired or at least confirmed scientifically which previously had only a remote connection with school education or none at all. Educational legislation and pedagogical therapeutics or orthogenesis must be based on science, i. e., on general scientific truths, not on educational idiosyncrasies and personal partiality. First of all we must see the truth, i. e., we must know exactly what pupils are, what their development is, and for what they are fitted.

What is Intelligence?

Take for example the problem of intelligence. Are the differences between the bright and dull pupils differences in kind or in degree? What is really intelligence? Is it inherited or acquired, or both? Can we distinguish general intelligence (innate, unspecialized mental efficiency) from acquired knowledge, interests, dexterities, and from specific endowment, aptitude or talent? Some believe that the child is bad by nature (Francke, Palmer, Graser); others claim that the child is good by nature, but it is spoiled by its environment (Rousseau, Pestalozzi, Froebel); still others claim that a child is neither good nor bad, it has only general unspecialized dispositions which may be developed in either direction (Wundt, Judd). Or, in regard to the pure intellect some believe that the child's intelligence is inherited (so-called *nativistic* theory of Galton, Pearson, De Candolle); others claim it is acquired (Sidis's *empiricism*); and those who share the theory of *genetism* (G. Stanley Hall, Dean Balliet, Horne) say that the child's intelligence is both inherited and acquired.

Meumann thinks that all these more or less different theories may be good for their own purpose, and a teacher who is dealing with a normal school child must judge a pupil's intelligence not only by its accomplishment of school tasks, but also by the energy (effort and time) expended in reaching this goal. Thus, three pupils may have the highest mark (A) in solving an arithmetical problem, but one did it in 3 minutes, another in 30 minutes, and the third in 60 minutes. All three had the same, highest mark. Which is the brightest? Or in memorizing a poem all three receive mark A, but one needs 3 repetitions, another 30 and another 60 repetitions. Who is the brightest? Meumann gives, therefore, the following formula to determine a child's school intelligence:

$$\text{School Intelligence} = \frac{\text{Work Done}}{\text{Energy Expended}}$$

Estimating Intelligence.

He mapped out a plan of studying general intelligence of normal pupils, dealing with it not as a whole, but only with some of its higher capacities. For these higher functions of intelligence he suggests material which involves the ability to work with abstract material in a purposive way, seeing new relations and breaking up old combinations. He disagrees, therefore, with those (e. g. Ebbinghaus) who claim that intelligence is the capacity to form new and original combinations, because a witty man does

The ergograph is an apparatus used to study fatigue.

(Concluded on page 152)

The Ten Greatest Inventions of Our Time

We hear much of the great inventions of the past—the telegraph, the sewing machine, the telephone, the reaping machine, photography, Bessemer and open hearth steel, the steam engine and the phonograph. Yet the inventions of our own time are as epoch-making and as dramatic as these.

Perhaps because we have become accustomed to the use of the old machines and discoveries, perhaps because the achievements of latter-day inventors succeed one another so rapidly that we are not given much time to marvel at any one of them, we have not fully realized how stirring and wonderful are the products of modern ingenuity.

Only five years ago the man-carrying aeroplane made its first public flights; only the other day hundreds of passengers on a sinking ship were saved with the aid of wireless telegraphy. At least a dozen inventions as great have been perfected in our own time, and all of them have made a man's work count for more than it ever did before, and have made the world more livable than it ever was.

Why should we not tell the story of our own deeds?

Why should we not review the industries created by men who are still living, men whose names will go down into history with those of Watt, Morse, McCormick and Howe?

That was the underlying idea of the November Magazine Number of the Scientific American. We knew that the "ten greatest inventions of our time" was a big subject when first we planned the number, but how big it was we never realized until we surveyed the field of modern invention.

Then we saw how astonishing was the progress made in our own day, how much mankind had benefited by the inventions of great modern intellects. We began to appraise inventions, to weigh one against the other, and to determine in our own minds which ten had contributed most to human progress and happiness, which were really great pioneer inventions, and which merely remarkable and valuable improvements on successful past conceptions. There were so many achievements to consider that it was hard to arrive at a definite conclusion.

The upshot of our own thinking has been to leave to our readers the decision

What Are the Ten Greatest Inventions of Our Time, and Why?

For the Three best articles on the subject, the Scientific American offers in the order of merit, three cash prizes:

First Prize: \$150.00 for the best article

Second Prize: \$100.00 for the second best article

Third Prize: \$50.00 for the third best article

Write for the Conditions of the Contest.

Teaching from the Child's Point of View

(Concluded from page 141.)

not add to our knowledge, though he is facile in new combinations, and in any case, only that man can be original who can cut himself loose from current associations. He says that there are the systematizers and critics, predominantly synthetic and analytic, respectively, but the highest degree of intelligence possesses great power in both synthesis and analysis.

In his study in connection with the intelligence of over 800 pupils Meumann found that not infrequently very bright school children show a slow immediate reproduction, whereas less intelligent pupils exhibit a quick and fitful reproduction, showing less capacity of mental effort, and indicating less attention to the content, together with a tendency toward less resistance in reproduction.

He concludes that wealth of imagery and originality of reproduction, without, however, any departure of the subject from the type proper to his stage of the development, are characteristics of intelligence. Dull pupils reproduce, e. g., words frequently named together, and depend much on what has been learned at school for the material as well as the form of reproduction; their imagery is not so concrete as that of the bright child. Dull pupils also use verbal imagery to a larger extent than bright pupils, thus tending to approximate to the adult type of thinking and consequently appearing in this regard precocious. His results show that the degree of mental development of pupils is ascertained by their capacity of abstraction, and can be recognized by their retention of abstract words, since such retention is mainly dependent upon their ability of understanding the words. He asserts that the positive relation between memory and general mental proficiency of pupils is very striking.

On the basis of the present writer's experiments in the Zürich laboratory Meumann speaks very critically of the popular notion that the child's memory is superior to that of the adult, because these experiments show that the child needs more time and more repetitions in memorizing than the adult. Thus, an adult needed 10 repetitions to memorize a series of 12 nonsense syllables, and a school child needed 63 repetitions to memorize the same series. Of course, there is a falling off after maturity in the capacity to learn new and disconnected facts, but this inability must not be taken as a characteristic of anything except the commencement of the disabilities of age.

A Scientific Study of Children.

In his tests of the memory of school children alone and when working together he found that the class-room disturbing influences (the noise of writing, walking about, whispering, the sight of the movements of the pupils, the occasional words of the teacher, etc.) have no special influence, i. e., the pupil shows better results if he works together with other pupils in the school than if he works alone, isolated. These differences in memory for the individual and the common test were strikingly large in cases of the younger children. One day he asked a number of the pupils in case of the individual tests whether they would prefer such exercise in the class or alone; 80 per cent of the pupils gave the decided answer that they would prefer to do the work in the class-room. In one other experiment he tested repeatedly a few 13- or 14-year-old-pupils with the dynamometer and his ergograph, and found that in the case of the tests of the pupils separately, with no one else in the room, the quantity of work was always less than when the others were present.

In many other of his investigations of the pupils he found great and interesting individual differences. But he does not want to push the doctrine of individual differences in pupils to the extreme, because we should thus make a science of education impossible, for science cannot account for the individual; a science of

PATENT ATTORNEYS

OVER 65 YEARS' EXPERIENCE
PATENTS
TRADE MARKS
DESIGNS
COPYRIGHTS & C.

INVENTORS are invited to communicate with Munn & Co., 361 Broadway, New York, or 625 F Street, Washington, D. C., in regard to securing valid patent protection for their Inventions, Trade-Marks and Copyrights registered. Design Patents and Foreign Patents secured.

A Free Opinion as to the probable patentability of an invention will be readily given to any inventor furnishing us with a model or sketch and a brief description of the device in question. All communications are strictly confidential. Our Hand-Book on Patents will be sent free on request.

Ours is the Oldest agency for securing patents; it was established over sixty-five years ago.

All patents secured through us are described without cost to patentee in the Scientific American.

MUNN & CO., 361 Broadway, New York
Branch Office, 625 F St., Washington, D. C.

Classified Advertisements

Advertising in this column is 75 cents a line. No less than four nor more than 12 lines accepted. Count seven words to the line. All orders must be accompanied by a remittance.

AGENTS WANTED

WANTED—One person each locality as agent for complete line Polish Mops, Self-Wringing Mops (5 styles), Fibre Brooms. Line cannot be duplicated. Hilker Mop Co., 1366 Grand Ave., Chicago, U. S. A.

YOU CAN'T AFFORD to accept ordinary propositions while agency for Guaranteed Aluminum Cooking Utensils is open. Answer quick. Protected territory. Am. Aluminum Co., Dept. 48, Lemont, Ill.

BUSINESS OPPORTUNITIES

SALESMEN making small towns, *Whole time or Side-Line*, should carry our fast selling, pocket side-line. Special sales plan allowing return of unsold goods. Makes quick, easy sales. \$4.00 commission on each order. *Something entirely new.* Write for outfit to-day. Burd Mfg. Co., 212 Sigel St., Chicago, Ill.

FOR SALE

FOR SALE—Two new 50 h.p. Nieuport type flying machines, one 4-cylinder, 50 h.p. Roberts Motor, propeller and radiator; also 50 h.p. Gnome, all in A1 shape. Address Ralph Cole, Norwalk, Ohio.

PARTNER WANTED

PARTNER WANTED with \$7,000 to \$10,000, active or otherwise, to engage in manufacture of portable work bench described elsewhere in this issue. Rare chance to acquire permanent, progressive property. Designed to fill a wide felt want in only practical way. Splendid manufacturing proposition, well ascertained existing demand. Address J. P. Mackay, 149 East 127th Street, New York.

PATENTS FOR SALE

FOR SALE—U. S. Patent, No. 1,051,728, and Canadian Patent 147,930. Lifts and Conveyors for invalid beds. For further information address: John German, Richland Centre, Wisconsin.

PATTERN LETTERS

PATTERN LETTERS AND FIGURES. White Metal and Brass, for use on patterns for castings. Largest variety, prompt shipments. Send for catalog. H.W. Knight & Son, 92 State St., Seneca Falls, N. Y.

INQUIRY COLUMN

READ THIS COLUMN CAREFULLY. You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. In every case it is necessary to give the number of the inquiry. Where manufacturers do not respond promptly the inquiry may be repeated.

MUNN & Co., Inc.

Inquiry No. 9310. Wanted addresses of manufacturers of good selling articles for mail order business catering to the trade of agents.

Inquiry No. 9311. Wanted names and addresses of manufacturers of hatpin heads made of colored glass; also medals of all shapes.

Inquiry No. 9312. Wanted to buy a machine which will pick up a weight the size of a lima bean by vacuum process. Must be able to pick up dust, gravel, etc. Must be operated by electricity and be easily portable.

Inquiry No. 9313. Wanted to buy Leather Held Horse Shoes used temporarily when shoe cannot be nailed on. In other words a Leather Boot with iron shoe at bottom—strapped over horse's foot.

Inquiry No. 9314. This enquirer is in the market for some patented articles which he could purchase and manufacture with an investment of from \$5,000 to \$10,000. The name of the party will be supplied to any of our readers on application.

Inquiry No. 9315. Wanted the name and address of a concern manufacturing novelty ink wells.

Inquiry No. 9316. Wanted the names of manufacturers and manufacturers' agents who make patented articles and other useful devices which appeal to the public and which can be used in a mail order business and by canvassers.

Inquiry No. 9317. Wanted the names and addresses of manufacturers of good selling articles that would appeal to the public where exclusive sale in certain territories can be arranged for; both to sell to the trade and through sub-agents in a house-to-house canvass.

Inquiry No. 9318. Wanted rollers and other appliances for extracting water and moisture from refuse, such as coir dust, with special reference for using it as a fuel.

Inquiry No. 9319. Wanted the name and address of concerns manufacturing novelties in table or pocket cutlery for the wholesale or mail order trade.

Inquiry No. 9320. Wanted an article suitable for large manufacturing—plant equipped for making Boats, Marine Engines, etc. The plant would be capable of making almost any article. A large wood-working establishment is also operated in connection with the metal shops.

Inquiry No. 9321. Want name and address of a firm who could make a machine for turning out rat buttons. The machine must be capable of making the dough of the exact size required, and also a machine to manufacture the tins and a machine for placing the dough in the tins. Preferably this machine should do all of this work in one operation.

education gives pedagogical principles as principles, i. e., as fundamental rules, and as such they must be impractical, for it is only when the rule is applied that we have something practical. Meumann claims that what we want now from a science of education is to know not so much the minute differences between individual normal pupils as what is true generally. In his investigations of individual differences among pupils he found special types of learners in each branch of work, and a knowledge of such types is more important for class teaching than that of minute individual differences. When means have been devised to determine these individual differences and certain uniformities we shall be able to classify, grade and promote pupils scientifically, and not divide them according to ages or sizes or school marks, as has been suggested and practised, as more satisfactory. Experimental pedagogy would also enable us to know what are the limits set by innate conditions to the work of education, and even to the selection of a trade or profession and work of life itself. Chancellor E. E. Brown rightly said recently that the practical dictum of this new pedagogy is that every large community needs a "clinic" where parents and teachers may receive advice on school matters, a "consulting engineer" in educational affairs.

Buying and Selling Silver and Gold

(Concluded from page 145.)

sunk, making a $\frac{1}{2}$ -inch rim around the whole table, thus preventing drops of the electrolytes from falling on the floor. The floor of this room, and the eighth, or gold, room is made of soapstone slabs, so that any spill of acid or electrolyte does no harm. A centrifugal hand rubber pump lifts the foul electrolyte from the level of the cells to that of the precipitating tanks and for this purpose is much superior to the reciprocating type, as there are no valves under which small pieces of foreign matter may lodge, interfering with the proper action of the machine.

The eighth floor contains the gold cells, which, with the exception of the sweep cellar, completes the plant. The gold cells are set on soapstone topped tables. There are two tables, each holding two sets of twelve cells, with a heavy soapstone dividing slab through the middle. On the top of the dividing slab, electrically driven, runs a light shaft line with pulleys at proper intervals. The propellers are carried on wooden arms bolted to the central slab and are driven by a light belt from the shaft line. In cleaning up, the entire top of the cell is exposed, thus giving the man in charge ample space for lifting out anodes and slimes. A large soapstone hood with wire reinforced glass for sides, gives the proper facilities for the treatment of platinum and palladium solutions.

A testing laboratory is partitioned off from this floor, in which all the foul solutions are tested for values before they pass to the sewer. The different electrolytes are tested for their strength of acid and metal values and also any necessary experimental work done.

The sweep cellar has been put in operation recently and its equipment consists of a jaw crusher which crushes the sweeps to one inch or less in diameter, one mill with 60 mesh screen which grinds the sweeps under water until they are fine enough to pass through the screen to the two settling tanks, and a steam drier. The type of mill is a standard mining machine where the rolls revolve and the pan remains stationary. It is of sufficient size so that it will not be necessary to keep the mill in continuous operation, and the men will be available in other places.

The drier constantly agitates the wet sweeps so that they cannot bake on the bottom. One settling tank is directly above the other and the lower contains a steam syphon which lifts the water to the upper. From the upper tank there is an overflow to the sewer and a connection which leads the water back to the mill so that it may be used over again.

A Gyroscopic Mechanism for Recording Roll and Pitch of Vessels at Sea

(Concluded from page 149.)

tically free from response to all other components of motion.

The rolling and pitching records are made upon two rolls of paper six inches in width driven by the same small motor at the same rate. There is also provided a means of marking the seconds on the record, and the center or base line from which it can be determined to which side any particular roll was made. The level of the records is about four feet from the base of the machine and the entire equipment is self-contained and portable.

Some idea of the extreme accuracy of the apparatus can be obtained from the following report of a test: The vessel on which the machine was mounted was floated in the bottom of a dry-dock, the water being drained down to 18 feet. The weather conditions were excellent, with practically no wind, and the vessel was almost entirely protected from any outside influences by the sides of the dock. There were used three plumb bobs on lines $12\frac{1}{2}$ feet long, the bobs being submerged, and the movement of the pencil was constantly checked up by the lines. The vessel was under constant motion and every motion was perfectly apparent and could be easily recorded. Whenever the boat settled to an extremely small fraction of a degree of roll, the center was determined with great accuracy and it was found that at no time had the gyroscopic pendulum of the apparatus moved a hair's breadth. This was further corroborated by the position of the levels connected with the pendulum. Interest, of course, centered upon the return of the datum point at the end of the test, and it was found that the pendulum returned to within less than $\frac{1}{64}$ of an inch of its original position. It was first thought that this was an error of the apparatus, but upon comparing results it was found that the vessel itself had not come back to within $\frac{1}{8}$ of an inch of the bob lines, which exactly checked with the reading of the gyroscopic recorder.

Large List of Prizes in 1914 Rubber Exhibit

THE fourth International Rubber and Allied Industries Exhibition, in conjunction with the first International Cotton, Fibers and Other Tropical Products and Allied Industries Exhibition, is to be held in London from June 24th to July 9th, 1914. The object of the exhibit, like that of its predecessors, is to promote trade and commerce with all rubber-producing and consuming countries, as well as to bring together producers, manufacturers, chemists, scientists and dealers in rubber products both crude and manufactured. The exhibition will permit of the display of the principal commercial products of rubber grown in the soil, as well as manufactured products, machinery, and appliances. Many of the British and foreign governments and associations have already expressed their willingness to being represented in the various departments.

One of the most important features of the announcement is the offer of a large number of prizes to exhibitors in the different departments. The committee of the Rubber Growers' Association will conduct a series of six contests, offering prizes as follows: First, medals for the best commercial samples of crepe, smoked sheet and assorted grades of plantation rubber; second, a gold medal for the best exhibit connected with plantation rubber grown in the middle East; third, a prize of £50 (\$250) and a gold medal for the most valuable improvement connected with the collection or preparation of plantation rubber; fourth, gold, silver and bronze medals for the three best exhibits of manufactured rubber flooring in tile or sheet form; fifth, a gold medal for the exhibit composed of the greatest variety of articles made from rubber for commercial purposes; sixth, £50 (\$250) and a gold medal for the most valuable discov-

The high point
in tobacco making.

Its wonderful Flavor
and Fragrance will de-
light YOU TOO.

Packed in the 90
Cent glass humi-
dors and the handy
5 Cent tins.

The glass humidor
keeps its tobacco
fresh indefinitely.

The HALF SIZE
5 Cent tin holds just enough to keep
fresh and perfect until it is smoked.

EVER-LASTING-LY GOOD

A Home Made Alternating Current Motor

MUNN & CO. Inc.
361 BROADWAY
NEW YORK

Read Supplement 1688 for a good, clear article by F. E. Ward, E. E., on the making of a one-eighth horse power alternating current motor. The motor can be constructed by anyone of ordinary skill in the use of tools who has access to a screw-cutting lathe with a swing of nine inches or more. The motor is designed to run on the 100 to 120 volt, 60-cycle, single-phase alternating current circuit, now in wide-spread use for the lighting of dwellings. The motor will drive a 16-inch brass fan, a small lathe, or a 50-watt dynamo for generating direct current for charging storage batteries, and in fact will do almost any kind of work that can be done by one-man power. Order from your newsdealer or from us.

TYPEWRITER AGENTS WANTED

Get in Business for Yourself

SAMPLES AT WHOLESALE

Fox Typewriter Company
GRAND RAPIDS, : : MICHIGAN

Big commissions—monthly payments—trial shipments—new stock—visible models—low wholesale prices. New advertising now ready.

Write today for Agency offer. Mention Scientific American.

Use the
Coupon

FROM A SCIENTIFIC AMERICAN READER
Name.....
Address.....
Business.....