SCIENCE

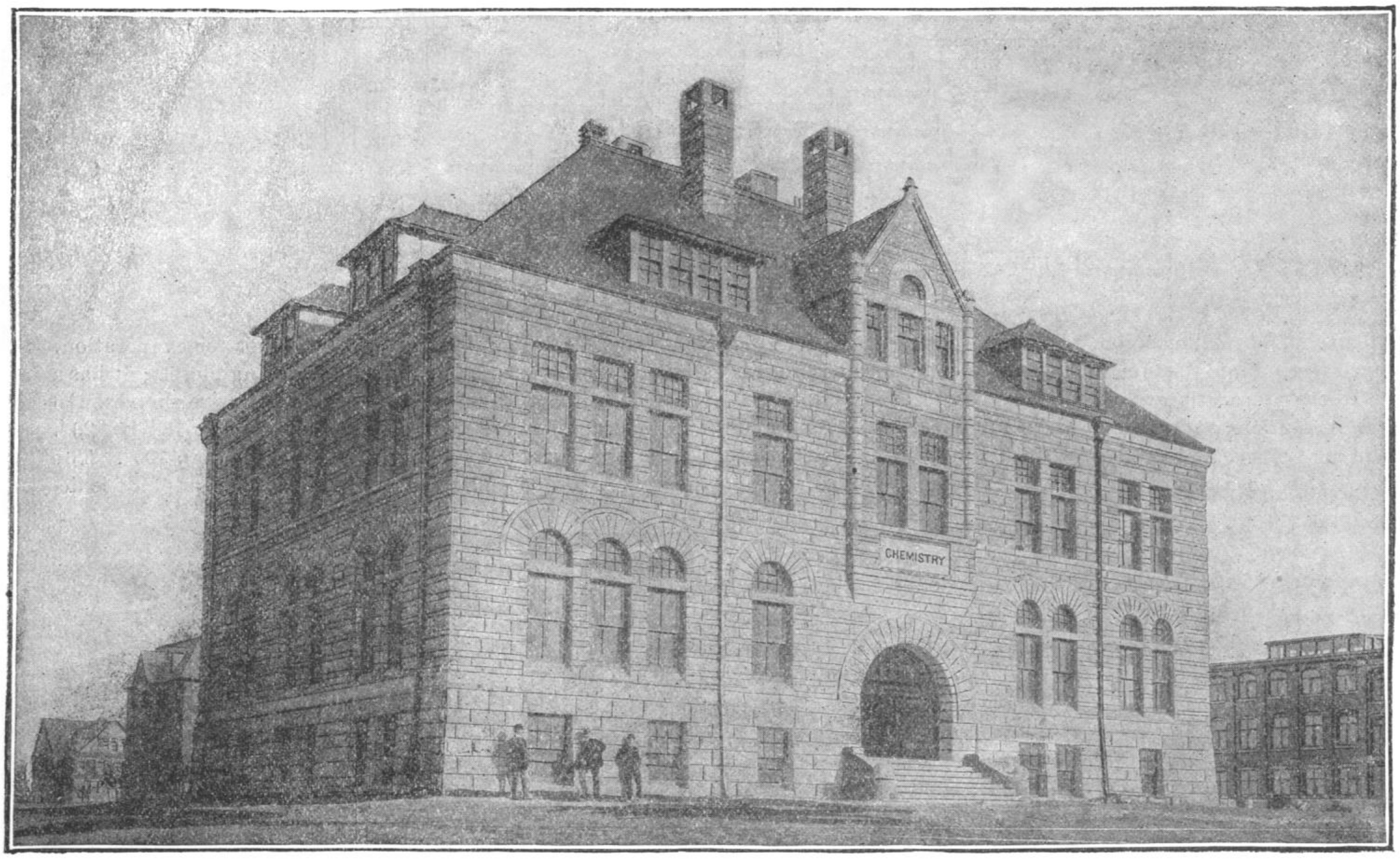
NEW YORK, MAY 13, 1892.

THE NEW CHEMICAL LABORATORY OF THE CASE SCHOOL OF APPLIED SCIENCE.

WITH the rapidly increasing attendance in all institutions of learning, it is hazardous to plan buildings for educational purposes with only sufficient room for present needs or for prospective growth in the immediate future. Every prosperous institution has abundant evidence of this fact in the necessity for enlarging buildings that a dozen years ago or less were regarded as ample in their accommodations, or in the overcrowded condition of those that do not admit of extension. This is especially true of the chemical laboratory, in which within fifteen years the demand for practical instruction has increased several fold. In some respects provision for prospective enlargement is not consistent with the best construction of a laboratory, yet with the necessity of providing for elementary laboratory training of large freshmen classes still rapidly increasing in numbers, it would be unwise not to include ample provision for future growth.

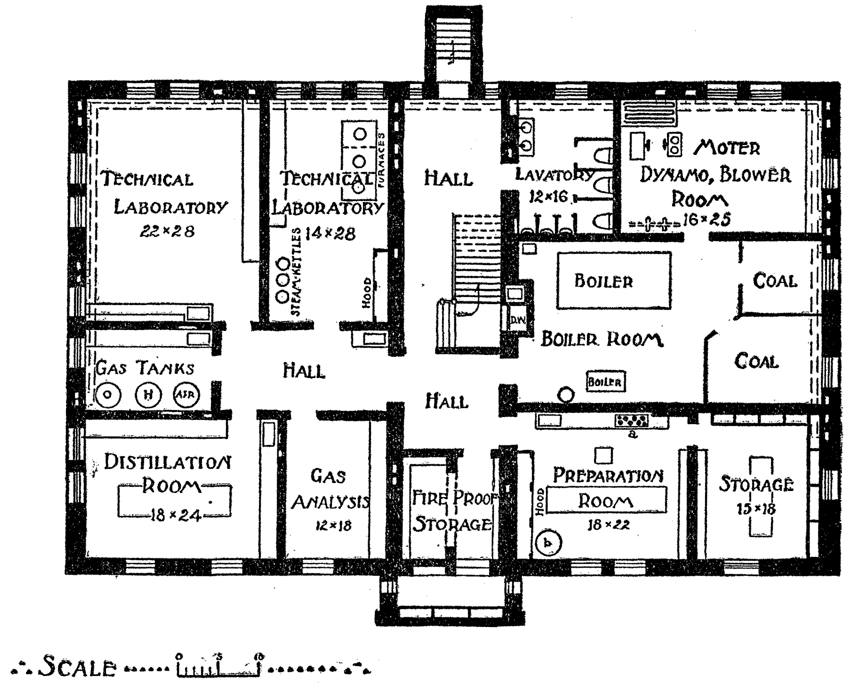
In devising plans for this laboratory, while I felt that it was not good economy to construct a building several times larger than present needs demanded, I was impressed with the importance of providing for the possibility of unlimited extension, especially in the earlier years of a school of science. The building was therefere given a plain, rectangular form, and it was found that extension of the main hall into a wing of any size would not interfere with a convenient arrangement of the rooms for present use.

As shown in the plans two stories are included beside a high basement and an attic floor. Each story is 16′ high, and the attic is the equivalent of another story, through the aid of large dormer windows, leaving still an ample space above for general storage. The basement is 13′ high, and the floor 4′ 6″ below grade. An elevator, capable of carrying a load of several hundred pounds, connects with all the floors above the basement.



Laboratory Case School Applied Science, Cleveland,* Ohio.
Buff Amherst Stone. S. R. Badgley, Architect, Cleveland, Ohio.

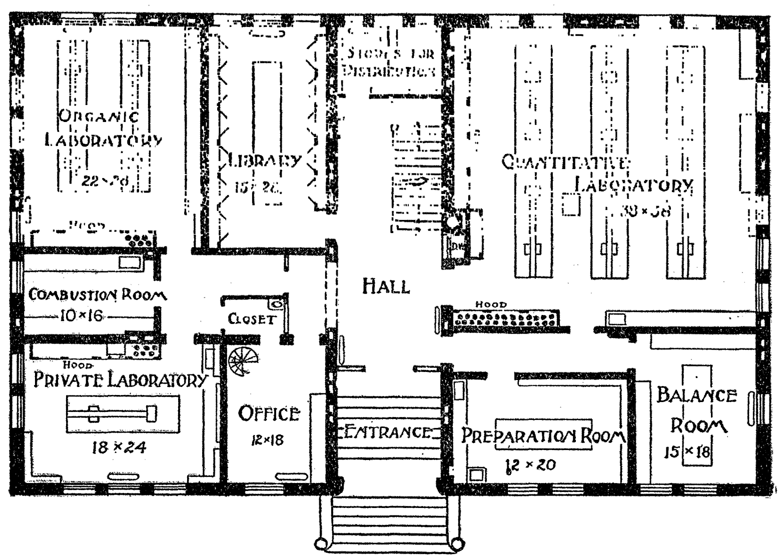
The outside walls of the building are of Amherst sandstone, with all inside surfaces of stock brick laid in red mortar, except within the hoods a special form of vitrified brick is laid. The basement floor is of Portland cement throughout, and the quantitative and general laboratories have floors of asphalt laid 1¼″ thick. All flues for hood ventilation are built into the cross-partition walls, the outside wall carrying the inlet flues for room ventilation to the basement, where they are connected by a 14″ iron pipe, shown by the dotted lines near the outside wall, to the blower in the motor room. The position of the three horse-power motor, blower, counter-shaft, and a steam coil for heating the air when necessary are shown in this room. A large tubular boiler supplies steam for laboratory uses, beside heating the building. It is inclosed in brick, and air is brought into the enclosed space through an outside flue and carried to the quantitative laboratory above, which is sufficiently warmed by this means even in the coldest weather without the aid of steam. The smaller boiler is for high-pressure steam, and it is connected into the pipe supplying steam to the laboratories.



BASEMENT.

In the preparation room, on this floor, the janitor prepares solutions and other material in general use throughout the laboratory. A large steam sink, *a*, with holes of sufficient size to admit a three-litre flask, is extremely convenient for making solutions. The tank, *b*, supplies hydric sulphide through lead pipes to the larger working-rooms. The space under the entrance steps is enclosed in masonry and iron doors for the storage of inflammable material. Distillations are conducted on slate tables in a room with the wood-work covered with sheet-iron. For lighting the central hall the doors of the adjacent rooms are glazed. Three gas tanks, each with a volume of 50 cubic feet, supply gases to the combustion-room directly above and to the lecture-room.

The quantitative laboratory on the first floor has 48 desks covered with porcelain tiles, like the other working tables on this floor. A steam hood has separate cups for evaporation, and the space beneath is enclosed for drying closets; it has a metallic lining with a large steam coil and wire shelves. In the general hood are two copper plates, each 18″ by 20″, above long burners for temperatures higher than 100°. The smaller hood contains the air-baths. Hydric sulphide is delivered from the lead pipe directly beneath a flue-opening. All hoods are glazed throughout with sashes running between a stationary inner and an outer sash, to protect the cord and to extend the efficiency of the hood to the lower level of the running sash. To avoid obstructing the space with pillars, the ceiling of this laboratory is supported on a heavy iron

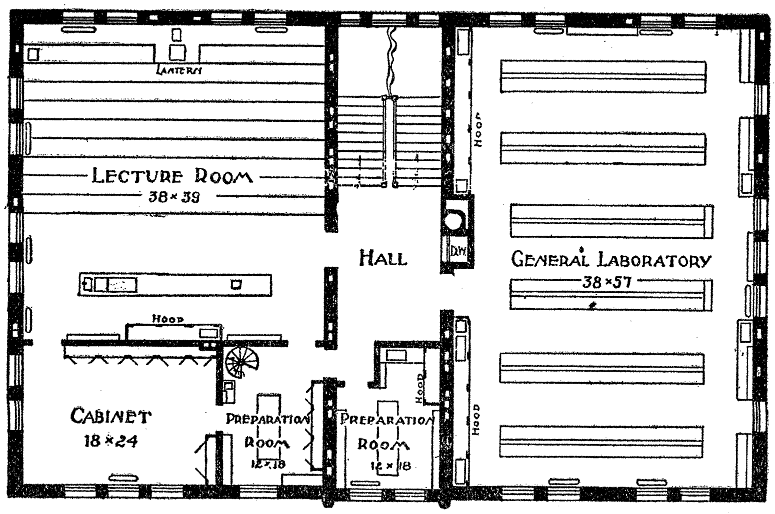


FIRST STORY.

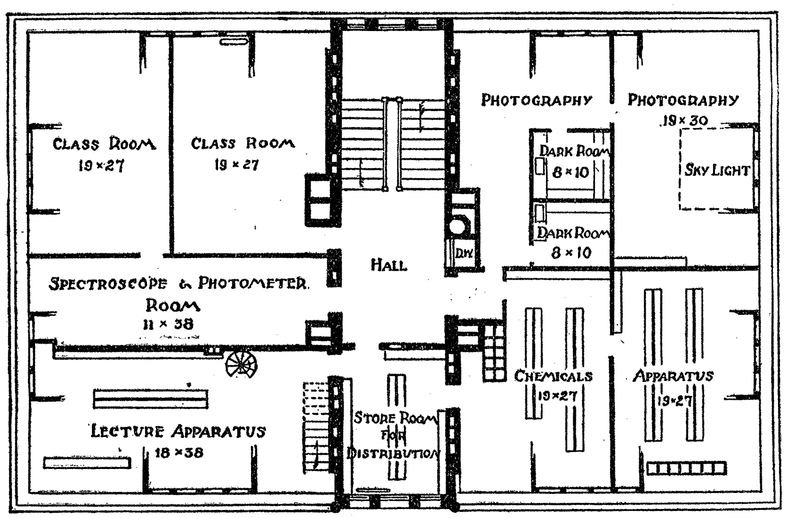
plate-girder thickly covered with asphalt paint. The organic laboratory has accommodations for twenty students, and as in most of the working tables on this floor and the basement there is an abundant supply of steam, water, and waste pipes for distillations and other uses.

The general laboratory on the second story contains ninety-six desks capable of accommodating one hundred and ninety-two students, and the light and ventilation[1] are all that could be desired. At either end of the outside aisle is a case of drawers beneath a table for material in sufficient quantities for large classes, and several shelves contain large bottles for solutions. The blast lamps in this laboratory and in the other principal rooms are supplied with air by a small pressure blower driven by the motor in the basement.

In the lecture-room 200 persons can be seated comfortably. The lecture-table is supplied with gas, water, steam, oxygen, hydrogen, blast, suction, and an excellent draught. In front of the hood are suspended two blackboards, one supporting the other, and a curtain falls from a spring-roller for lantern illustrations. In the rear of the lecture-room are the cabinet for collections and a preparation room, which is connected by a spiral stair with the office and with the room above, which serves for storage of lecture apparatus. The large dormer windows render the rooms on the third floor as serviceable for certain uses as they would be on a lower floor. A large amount of available room is thus secured without extending the outside walls to form a third story. A section of this floor devoted to photography contains two rooms one with two dark closets for students and instructors, the other with a large skylight for general work. Extension of the roof without interruption affords sufficient height to the flues to ensure good draught. The tops of the flues are eighty feet from the basement floor. Within the space enclosed in brick for the elevator, a stand-pipe is carried to the attic floor, with an opening, on each story, to which is attached a hose of sufficient length to reach every room.



SECOND STORY.



THIRD STORY.

Excavation for this building was begun June 1, 1891, and by the middle of February, 1892, all the working-rooms were in use. In the preparation of the working-plans, the architectural features, and in the substantial construction the trustees were fortunate in securing the skill, good judgment, and faithful service of the architects, Messrs Coburn and Barnum. Of the illustrations in this paper, the excellent view of the building is due to the courtesy of the Cleveland

[1] A description of the ventilation of this laboratory will appear in the American Journal of Analytical and Applied Chemistry.

Stone Company, who furnished the Amherst stone, and the reproductions of the floor plans to the kindness of the architects. CHARLES F. MABERY.

THE STATUS OF EXPERIMENTAL AGRICULTURE.

THE average farmer is eminently conservative when about his routine of work. He dislikes innovations as to methods and distrusts ways and means not clearly "practical." This obtains naturally from his life work. His maintenance depends upon the precarious lives of plants and animals, which in turn, in so far as they as beings are concerned, thrive or perish according to the fiat of life principles, of the working conditions of which, he, in common with the rest of humanity, knows comparatively little. Experiments are costly on the farm, time is cash in hand, and new methods or added work, either apparent or real, must be backed by necessity or success, else the usual method or condition will remain unchanged — "The good old way, good enough."

Because of this general conservatism, held principally in position by the abstruse nature of the principles of life, principles and practice of agriculture advance to place, gain permanence of character, recognition slowly, indeed, in comparison with development of other occupations, even with that of the adoption of farm conveniences, would at first thought seem almost at a standstill, so that, ease of work, convenience, better machinery and appliances, yet seem to leave the yield of labor much on an old-time basis.

This is the dark side of the prospect of agriculture; that, after all the years of man's efforts on the soil, virgin lands still predominate in yield, and regions once prosperous are no longer up to the standard of the new. Belief that such should of necessity have occurred, or that the present new shall eventually become as the old, need not here be disclaimed,— conditions differing much from those of old militate against such retrogression. The true agriculturist no longer rushes blindly along with or against working principles of nature, — taking all or getting nothing according as her resources yield to methods used, — but stands in many aspects master of principles which, under rational control, constantly tend toward lasting improvement, greater returns in every field of labor.

Aside from that which accrues from rapid general enlightenment, many factors unite in this country to place principles of agricultural pursuits upon a higher plane, amongst which may be named the rapid occupation of available wild lands — the removal of a strong incentive to those of most changeful mood as to locality. But by far the most hopeful aspect, the condition most distinctive of agricultural development, is the recognition of the idea of experiment and the value of such effort upon the farm. Many, indeed it may be said almost all of the most enlightened, successful farmers spend a great part of their individual time in work of an experimental nature, such work as a few years since would have been spoken of as "puttering boy-play." While, as previously noted, agriculture as an occupation has in general, from the beginning, made less definite systematic advance as to principles of action than that noted in other professions, this can scarce be said of its later years. Indeed, it is hardly to be questioned that in the last decade greater progress has been made in agriculture as a science, more definite principles of procedure gone into test than in all other occupations of the country. Never before has the farmer been so willing to accept, try new methods, acquiesce in scientific theories and demonstrations; questions that never broke through the cloud of sadness mantling the face of the fate-beridden agriculturists of yore are handled, discussed, and worked upon in the light of experimental effort, often with results most pleasing and not without pleasure even in case of economic failure; for, with men who compile results, negative ones are no longer considered as not to be counted. Questions concerning effect of crop on soil, soil on crop, crop on that which follows are in test by every cultivator of enterprise; stock-breeding is made to follow definite laws of development, desert lands made to yield, and diseases of plants and animals, that of old were pests sent by chance or the Evil One, not to be availed against, meet a man actively prepared to resist according to the dictates of reason and direction of those who have previously succeeded or may authoritatively advise.

While the average farmer is thus markedly in an experimental mood, willing to test as is best known, few have time or bases of fact for initiation of experiments. Herein lies the legitimate work, duty of the experiment station, and with wise provision of the general government, every State and Territory in the country is possessed of such an institution. From the first establishment of these institutions, the impetus given to proper agricultural investigation has been most noteworthy. While more has generally been expected of them than has been forthcoming, yet in this connection it is to be remembered that experimental facts are established only after a proper lapse of time. Nevertheless, much of the work, as shown in the published reports and bulletins, is more fragmentary and less indicative of efficient experimental effort than an enthusiast would wish.

There are numerous reasons for the unexperimental indication of many station publications pertinent to anyone conversant with such work. But, aside from all such apparent elements as may vex the ultra-scientific mind, none bears heavier upon the future usefulness of the experiment station than the varying ideas within the stations themselves as to the true mission of the experiment station. Is it primarily educational for the dissemination of facts not commonly known, or is it experimental — to delve after that which is unknown? Among the stations, types of both are to be found, but many are hybrid. Few publications outlining attempts at pure experimentation are open to harsh criticism, but many most lamentable conglomerates appear as the result of the other two ideas. Perhaps attempt at methods "practical" and writings "popular" is an *ignis fatuus.*

Closely associated with this indecision of purpose is the point of how much should be undertaken. In general, it may be said of the individual stations that too broad a field is attempted, considered from the standpoint of the whole force, and with few exceptions with reference to individual work. Only such an expansive (more properly, perhaps, filling) effort, or a disregard of the literature of the subject, could result in a *résumé* upon "Wheat Rust (*Uredineæ*)," appending a recommendation of same preventive applied to smuts of small grains. In this connection remarks upon the effect of unfortunate recommendations upon experimental ardor of the farmer are unnecessary.

With the possible exception of experiments directly relative to the soil, results of scientific worth reached at any one station will commonly be found generally applicable. In order to attain something like systematic effort, and to prevent useless, costly repetition, it may yet be found effectual, necessary, to league the experiment stations of the country. Each station could support one or two departments of investigation without materially curtailing effort in either; it cannot do all.

Though waning, much evil to true experiment is centred about an idea based upon the much abused words practical and popular, i.e., the farmer should see from the results, good crops, fine stock, etc., that the station is practical — it must be popular. Such a condition is well, but may be a delusion so far as experiment is concerned. It is not enough for an experiment station to show that it has been able to raise an average of forty bushels of No. 1 hard wheat per acre, for a period of ten successive years. It is not enough to compile facts merely for educational (popular) effect. The farmer who is looking for properly initiated experiments, the man who is able to appreciate such and profit by them to the enlightenment of his less able, less active neighbors, while he may be interested in such evidences of capability, rightfully expects more. The station management which, after a decade, has only succeeded in well accomplishing work similar to that indicated will nevertheless be in logical position to answer the question: In how much have you augmented the aggregate of working principles of agriculture ?

H. L. BOLLEY.

Government Experiment Station, Fargo, N D.

NOTES AND NEWS.

MISS AMELIA B. EDWARDS, who died recently, has in her will endowed a Chair of Egyptology. Her library, which is very valuable, she has bequeathed to Somerville Hall, Oxford.

— Professor Liversedge, of Sydney, in a recent paper, states that iron rust is usually considered to be an hydrated sesquioxide of iron; but, on examining a very large number of specimens of rust from many different places and formed under a great variety of conditions, he found that in almost every instance the rust contained more or less magnetic oxide, in fact, in some cases the rust, though presenting the usual rust-brown color and appearance, was, when powdered, wholly attracted by a magnet.

— In addition to the Grand Honorary Prize placed at the disposal of the Boston Society of Natural History, by the late Dr. William J. Walker, " for such investigation or discovery as may seem to deserve it, provided such investigation or discovery shall have been made known or published in the United States at least one year previous to the time of award," which has been unanimously awarded to Professor James D. Dana, referred to in *Science* of April 29, the Society has awarded, from the annual Walker Prizes, a first prize of one hundred dollars to Baron Gerard de Geer of Stockholm, for an essay entitled " On Pleistocene Changes of Level in Eastern North America," and a second prize of fifty dollars, to Professor William M. Davis of Cambridge, for an essay on " The Subglacial Origin of Certain Eskers."

— Mr. James M. Macoun of the Canadian Geological Survey Staff, who accompanied the British Commissioners to Behring Sea last year as secretary, has left Ottawa *en route* for Alaska, to observe the habits of the fur seal during the present season. It is proposed that he shall go over the same ground which the Commission traversed last year, to examine specially whether there is any variation in the numbers of the seals. Last year the photographer of the expedition succeeded in obtaining a large number of excellent views of the rookeries, which will furnish a good basis for comparison with a similar set to be taken this summer. Mr. Macoun expects to spend the early part of the season on the Aleutian Islands, proceeding to the Pribyloff Islands only when the seals gather there for the summer.

—It is well known that serious loss is caused in the various Australian colonies by the ravages of the rust fungus in wheat. An Intercolonial Conference, as we learn from *Nature*, met to consider the subject in 1890, and this body has since held two other meetings, the third having taken place at Melbourne last month. Many experiments have been made, and it has been clearly shown that there are several varieties of wheat which, except under very unusual circumstances, are never seriously attacked by rust. It has also been shown that in many districts early sown wheats of a rust-liable kind generally escape damage by rust, when the same wheats sown late suffer seriously. In view of these facts the Conference has directed attention mainly to encouraging the growth of varieties less liable to be attacked by rust, and also to early sowing. At the March meeting it was recommended that a practical system for the production and distribution of rust-resisting wheats suitable to different districts should be immediately established, and that this system should, subject to modifications needed by each colony, be conducted on the following lines: A central station for each colony for the preliminary testing of new wheats introduced into the colony; for the production of new varieties by cross-fertilization and by selection; and for the distribution of suitable wheats thus obtained to representative districts of the colony, to be there subjected to a sufficient test, and, if necessary, fixed in their characters by farmers and others competent for the work; and that such wheats as pass satisfactorily this test should then be distributed to the farmers around in such a manner and by such agency as would be most suitable to the conditions of each colony. A committee was appointed to take steps for the proper naming of the different varieties of wheat.

— At the meeting of the Royal Meteorological Society, the 20th of April, a paper was read on " Anemometer Comparisons," by Mr. W. H. Dines. This was a report on a valuable series of experiments which have been carried out at the request of the Council of the Society with the view of obtaining a direct comparison of the various anemometers in common use, so that some opinion might be formed as to which type of instrument is the most suitable for general purposes. The Meteorological Council have defrayed the cost of the work. The anemometers which were compared were: 1, Kew-pattern Robinson; 2, self-adjusting helicoid; 3, air-meter; 4, circular pressure-plate (one foot in diameter), and 5, a special modification of tube anemometer. Most of these instruments are of the author's own invention, as well as the apparatus for obtaining automatic and simultaneous records from all the instruments upon the same sheet of paper. It appears that the factor of the Kew-pattern Robinson is practically constant and must lie between 2.00 and 2.20. The helicoid anemometer is quite independent of friction for all excepting light winds, and different sizes read alike, but it is not so simple in construction as the cup form. The air-meter consists of a single screw-blade formed of thin aluminium, and made as nearly as possible into the exact shape of a portion of a helicoid. A similar instrument with a larger blade and with the dial protected from the weather would probably form a useful and correct anemometer. It would be light and offer a very trifling resistance to the wind. The oscillations of the pressure-plate must have been considerably damped by the action of the floating weight, but as it was they were sufficiently violent. It seems probable that the remarkably high values sometimes given by the Osler pressure-plate may be due to the inertia of the moving parts. The tube anemometer appears to possess numerous advantages. The head is simple in construction, and so strong that it is practically indestructible by the most violent hurricane. The recording apparatus can be placed at any reasonable distance from the head, and the connecting pipes may go round several sharp corners without harm. The power is conveyed from the head without loss by friction, and hence the instrument may be made sensitive to very low velocities without impairing its ability to resist the most severe gale.

— In *The Studio* for May 7, Mr. Gaston L. Feurardent has an article reviewing the one written by Mr. Edward Robinson of the Museum of Fine Arts of Boston, Mass., and published in the *Century Magazine* for April: " Did the Greeks Paint their Sculptures ? " Mr. Feurardent, while giving Mr. Robinson full credit for the research and learning so amply shown in his article, finds himself unable to accept his conclusions so far as they relate to the painting of marble statues of the higher class.

SCIENCE:

A WEEKLY NEWSPAPER OF ALL THE ARTS AND SCIENCES.

PUBLISHED BY

N. D. C. HODGES,

874 BROADWAY, NEW YORK.

SUBSCRIPTIONS.—United States and Canada................$3.50 a year.

Great Britain and Europe................. 4.50 a year.

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Attention is called to the "Wants" column. It is invaluable to those who use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

THE POSSIBILITY OF A REALIZATION OF FOUR-FOLD SPACE.[1]

ANY magnitude that is a function of a single variable may be represented geometrically by a straight line. Functions of two variables are represented by curved lines or by plane areas; and functions of three variables by either twisted curves, curved surfaces, or volumes. The conceptions of length, area, and volume when used in this way are evidently independent of any of the properties of matter except extension. The question now before us is this, Can we develop and use in a similar way a space-concept which can fully represent a function of four independent variables?

Perhaps most of us can remember times in the course of our education when new conceptions of quantity entered into our conscious life, conceptions which correspond in a general way with those of length, area, and volume, in that they enable us to find at once such relationships as are most frequently required for practical purposes by a general, synthetic, instinctive method. A medical student, instead of memorizing the exact amount of each dose under all possible conditions of the patient, fixes in his mind as in a frame work the medicinal outline of each drug. The student of chemistry does something similar with the elements; the architect has such a concept of structural beauty; the hunter, of the most likely place for game. The sense of propriety, the sense of honor, and numberless other "inbred" or "instinctive" concepts are examples of this mental tendency. There is therefore nothing inherently absurd or improbable in the supposition that any of us may attain to a conception of four-fold space, "as clear as the designer and the draughtsman have of three-fold space."[2] Such a conception would be of great value to all classes of scientists. The biologist could set in this four-fold framework a complete picture of genetic or race relationships; the theologian could use it for the world of spirits; the physicist for forces, etc. By this means ordinary men may become able to see and to develop easily new truths, such as are now revealed only to men of genius and inspiration.

It may be objected that our conception of three-fold space is derived directly from sensations in three-fold space, and that the conception of four-fold space cannot be derived in a similar way, nor yet from sensations in three-fold space. But it is evident that from any sense, from sight, for instance, we get at most a two-dimentional sensation, and it is only by the kind of changes that occur in the sensation that we can infer that a given retinal picture represents extension in two or in three dimensions. In other words, granting, for the sake of the argument, that in sight we perceive directly the existence of two dimensions, it is clear that the existence of a third dimension is solely a matter of inference. It is the simplest hypothesis we can get to explain our sensations. It is conceivable that the hypothesis of a fourth dimension, if it could be made as real to us, might be found of nearly equal value in the simplification of ordinary phenomena. This would be the case if ordinary phenomena involve motion in four independent directions, or if some of the relations of things in the universe, relations not in space, are capable of complete representation in four-fold space. But before we can decide whether or not space and objects of four dimensions exist we must have our ideas of four-fold space developed sufficiently to know what sensations, what visible and tangible phenomena, would be obtained from objects of four dimensions. Up to this time discussions on the reality of four-fold space have been (necessarily) characterized by the absence of evidence for or against.

To develop a clear conception of four-fold space only one course seems to be open, namely, the synthetical study of four-fold geometric figures in the same way that we now study geometric solids. Having given the number and form of the boundaries of a solid we can, by the process of visualization, find more or less easily its appearance (plane projection) in various positions, the possible plane sections, the distance between any two of its points, and so on. In the study of a tessaract (four-fold figure) we should deal similarly with its solid boundaries, finding the possible solid sections, solid projections, and so forth, studying the tessaract by means of conceptions already familiar (length, area, volume), but in new relations. It this way may be developed gradually such a knowledge of the properties of tessaracts as will enable us to "see" them clearly, and to comprehend quickly a new shape. Models of the solid projections and sections are indispensible to rapid progress. Difficulties may, in general, be overcome by considering the analogous difficulties an imaginary plane being, that is to say, a being who has no conception of volume, would have in trying to understand a geometric solid.

The First Lesson.

A point moving in one direction traces a straight line. A line moving perpendicular to itself, in one plane, traces a square; and a square moving similarly traces a cube. How could a plane being learn the number and relations of the faces of a cube? He could readily understand that as the square moves in a direction perpendicular to all of its sides each side traces a new square, and that the moving square in its first and last positions forms the remaining pair of opposite faces. In this way he could count up the six faces, twelve edges, and eight corners of the cube, and might pro-

[1] Digest of a paper read before the Canadian Club of Clark University by T. Proctor Hall, Ph.D

[2] "A New E a of Thought," by C. H. Hinton, M.A.

ceed to make models of the faces as follows (Fig. 1). The side *ab* of the original square *abcd* traces the square *abfe*, which he places, as in the figure, in the only position known to him subject to the condition that *ab* is one of its sides. The three other squares are similarly placed as in the figure, and now five of the six squares are shown in positions which are correct with reference to their generating lines. But the corner *a* is in this figure represented as the generator of two lines *ae*, which is evidently incorrect. The outer squares

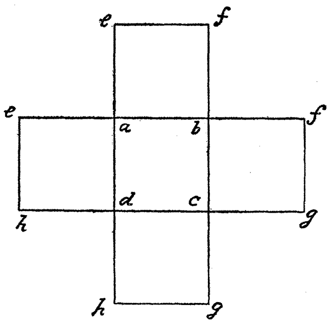

FIG. 1.

are therefore to be turned through 90° about their generating lines until the two lines *ae* become one and the four spaces between *ee*, *ff*, *gg*, *hh*, disappear. He cannot imagine how this is to be done, but he can suppose the central square to move away and disappear in the to him unknown direction, carrying with it the outer squares which would then appear to sink into the centre and disappear as they reached their generating lines until at last the lines *ef*, *fg*, *gh*, *he* reach the position now occupied by the sides of the square *abcd* and become in the picture, what they are really, the sides of the sixth square *efgh*. Supposing, in the next place, that the square *abcd* as it moves away is still visible, but smaller by perspective, the plane being could construct a model which is to us a perspective view of a cube and which would represent to him fairly well the relations of the boundaries of a cube (Fig. 2).

Let us proceed in the same way. A cube moving in a direction perdendicular to all of its faces traces out a rectangular tessaract. Each face traces a new cube, each line a square, each point a line. Counting up we find the tessaract

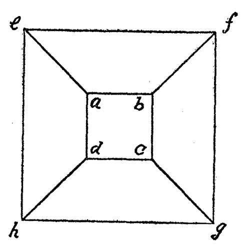

FIG. 2.

is bounded by 8 cubes; has 24 squares, which do not enclose the tessaract, but appear here and there as lines do upon a cube, interfaces, not surfaces; 32 lines or edges, and 16 angular points. A little calculation now shows that each face is common to two cubes, each line to three faces, and each point to four lines. All this seems very abstract, but it becomes real and evident when we make a model. Placing a cube on each face of the original cube, after the analogy of the plane being's squares, we have these six cubes in the only positions known to us which satisfy their genetic conditions (see Fig. 3). The eighth cube is represented by the outer faces of the six cubes, and it is evident that the three lines marked *cC* are really one, the two faces *bC* are one face, and so on. We may now imagine the central cube to move away in the fourth dimension and the others sink inward and disappear as they reach the present boundaries of the central cube, where they turn at a right-angle into the new direction. Finally all the outer faces will meet as the boundaries of the eighth cube *DF*. Supposing the cubes elastic, we may stretch their outer faces and diminish the inner until we obtain the perspective view of a tessaract, as shown in Fig. 4, where the relations of the various boundaries of the tessaract are more easily studied. Incidentally we have learned also that a solid section of the tessaract, when taken parallel to a cube-boundary, is a cube.

The Second Lesson.

Turning again to our imaginary plane being for suggestions, let us see how motion in the third dimension would appear to him. If a cylinder were passing perpendicularly through his plane he would see only a stationary circle, or if it were oblique, a moving ellipse. A cone would appear as a growing or diminishing circle, a beaded rod as an oscillating circle, a corkscrew as an ellipse moving in a circular orbit, and so forth. The stem of a dichotomous tree would be to him a wooden circle which, as the branches approach,

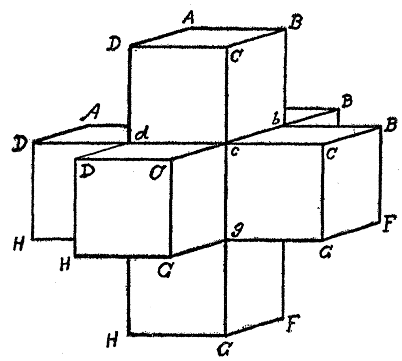

FIG 3.

widens out, becomes constricted, and finally divides into two circles, which repeat the process indefinitely. We may imagine a plane philosopher who, after watching this process for some time, constructs a theory of the evolution of circles. But his idea that all these circles have been developed from one is hardly more than a caricature of the truth.

Every person who has watched the self-division of infusoria under the microscope must be struck with the analogy of these two processes. A little reflection enables us to see that race-unity may be more than a figure of speech or a creation of the fancy; that the organic forms that existed for us yesterday and those that will exist for us to-morrow may be but parts of larger units of which the forms we see to-day are only solid sections. True, this is only a suggestion: but it is a suggestion that carries with it an unavoidable sense of freedom, of fetters loosed, of largeness, and of reality, to anyone who will for a time yield himself to its influence. It is a step toward the poet's view,

> "All are but parts of one stupendous whole,
> Whose body Nature is, and God the soul."

If four-fold space exists, it is evident that it must contain an infinite variety of three-fold spaces, of which we know only one. It must also be everywhere possible for a four-fold being to step out of our space at any point and re-enter it at any other point; for his relation to our space is nearly the same as our relation to a plane. If ghosts are four-fold beings, the erratic nature of their movements may become more comprehensible in the course of time. An ordinary knot could in four-fold space be readily untied by carrying one loop out of our space and bringing it back in a different place. In fact, a knot in our space would be simply a loop or coil in four-fold space. A flexible closed shell could be turned inside out as easily as a thin hoop can with us: and many other apparent impossibilities become mere child's play. But the realization of four-fold space cannot be learned by giving attention to such little curiosities as these. Only a systematic and continued study of the figures and motions of higher space can be expected to give results of

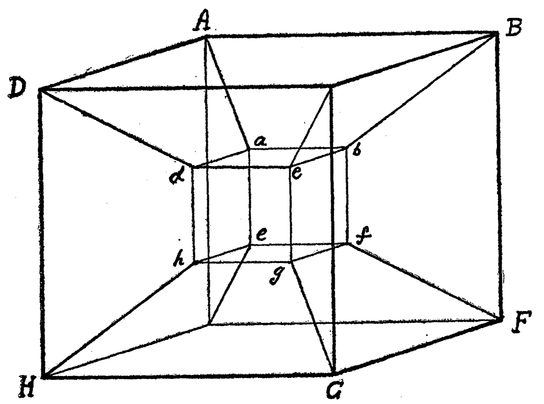

FIG. 4.

educational value. And when (or, if) our conception of four-fold space becomes clear, we shall be ready to recognize the existences and motions of the fourth dimension if there be such.

THE TUSKALOOSA FORMATION.

PROFESSOR LESTER F. WARD has recently spent a couple of weeks in Alabama in making a study of the Tuscaloosa formation, both as to its stratigraphy and its fossil plants. While in Alabama the professor made Tuscaloosa his headquarters, and from there made a number of short excursions in company with Dr. Eugene A. Smith to places of interest. At Cottondale, some eight miles east of Tuscaloosa, there is a fine locality for the collection of fossils, chiefly well-preserved leaf impressions. Professor W. M. Fontaine, a number of years ago, spent some time here and collected a great number of these leaves, which are now in the hands of Professor Ward for study and description.

Between Cottondale and Woodstock there are many occurrences of the Tuscaloosa sands and clays, which are now only outlying remnants, upon the rocks of the Coal Measures, of what was once probably a continuous mantle. Although there are many places where excellent clays for economic purposes are to be seen, none of them thus far examined have been found to contain the leaf impressions. From their position, these beds, occurring between Cottondale and Woodstock, appear to be the oldest of the Tuscaloosa series, and the leaf-bearing beds thus appear to be tolerably well up in the formation, although wherever seen, at Cottondale, Tuscaloosa, Snow's, Shirley's Mill, Glen Allen, etc., the leaf-bearing clays rest directly and unconformably upon the Coal Meas ures, usually within thirty or forty feet of the lin of contact of the two formations.

The other localities mentioned above, except Glen Allen, being away from the railroad lines, had to be reached by private conveyance.

Snow's, about seven or eight miles west of Tuscaloosa, was first examined by Dr. Smith seme years ago, and Professor Fontaine made a large collection here also. In the gullies near Snow's there is fine opportunity for seeing the strata of the Tuscaloosa formation, in vertical section. One of these is more than one hundred feet deep. Shirley's Mill, eleven miles south-east of Fayette Court House, was first made known as a plant-bearing locality by Dr. George Little, who visited it last year while making an examination of the Tuscaloosa clays, for the Geological Survey of the State. Dr. Little bro ght back a few fine leaf impressions from here, but Professor Ward was the first to make a systematic collection of the fossil plants. Glen Allen, on the Kansas City, Memphis, and Birmingham Railroad, was first examined and a small collection made by Dr. Smith several years ago, but here again Professor Ward was the first to collect on a large scale. The leaves are in a dark colored clay that at certain stages of wetness is tough and intractable, but when properly dry yields beautiful specimens at every st. ke of the hammer. The same is true of the clays near Shirley's Mill, and at both these places one can in a few hours load a wagon with fine cabinet specimens.

The Tuscaloosa formation is now generally considered a member of the lower Cretaceous, in part at least equivalent to the Potomac of McGee. While the fossils have not yet been sufficiently studied to decide their exact equivalence, many of the leaves appear to be identical with those occurring in the Amboy clays of New Jersey.

While in Tuscaloosa Professor Ward had an opportunity also of collecting some rare living plants. Upon the banks of the Warrior River, a few miles above the town, under the guidance of Drs. Bondurand and Hall, he was able to obtain *Neviusia Alabamensis*. *SedumNevii*, *Croomia pauciflora*, all comparatively rare, the first named having been found only in this locality. In Dr. Smith's yard is growing the *Croton Alabamensis*, recently discovered on the banks of the Cahaba River, and of interest as being the only shrubby Croton in our North American flora. This one grows to the height of eight or ten feet and makes almost impenetrable thickets. When slightly bruised the leaves and stems give out a fragrance somewhat like that of the flowers of the crab-apple.

An excursion was also made by Dr. Smith and Professor Ward to a little village, Havana, some twenty-five miles south of Tuscaloosa, long known to the former as an interesting locality, where, in a rocky glen under overhanging cliffs, grow two rare ferns, *Asplenium ebenoides* and *Trichomanes radicans*. The former has been noted from only three other localities, all in different States of the Union. Near Havana there are some great gullies, locally known as "The Caves," in which the micaceous sands of the uppermost of the Tuscaloosa formation are laid bare. These sands are remarkable for their brilliant colors, red, pink, purple, and yellow. In this respect they called to mind the similar bright hues of Gay Head in Massachusetts.

E. A. S.

MR. W. J. HUSSEY of the Ann Arbor Observatory has received an appointment as astronomer at the Leland Stanford, Jr., University.

ASTRONOMICAL NOTES.

[*Edited by George A. Hill.*]

Comet *a*, 1892.

THE following ephemeris of comet *a*, 1892, is from a hyperbolic orbit computed by Father G. W. Searle of the Catholic University, and is based upon observations made on March 10, March 29, and April 22, and represents very closely an observation made by Father Searle on the morning of May 6. The epoch is for Greenwich midnight: —

	R.A.			Dec.		log △.	Br.
	h.	m.	s.	°			
May 12	23	5	17	+ 28	5.3	0.1270	0.61
13		8	0	28	39.9		
14		10	42	29	13.7	0.1329	0.58
15		13	22	29	46.9		
16		16	1	30	19.4	0.1387	0.55
17		18	38	30	51.3		
18		21	14	31	22.5	0.1444	0.52
19		23	48	31	53.1		
20		26	20	32	23.2	0.1499	0.49
21		28	50	32	52.7		
22		31	19	33	21.6	0.1553	0.46
23		33	47	33	49.8		
24		36	13	34	17.4	0.1606	0.44
25		38	37	34	44.6		
26		40	59	35	11.3	0.1657	0.42
27		43	19	35	37.4		
28		45	38	36	3.0	0.1707	0.40
29		47	55	36	28.1		
30	23	50	11	+ 36	52.7	0 1756	0.38

Winnecke'e Perodic Comet.

Ephemeris continued from No. 482 of *Science*: —

	R.A.			Dec.	
	h.	m.	s.	°	
May 17	11	10	3	+44	29
18		8	50	44	27
19		7	39	44	24
20		6	28	44	21
21		5	19	44	17
22		4	9	44	13
23		3	0	44	9
24		1	50	44	5
25	11	0	40	44	0
26	10	59	30	43	55
27		58	18	43	49
28		57	5	43	44
29		55	50	43	38
30		54	33	43	32
31		53	13	+43	25

Bright Streaks on the Moon.

Professor Holden in No. 22 of the Publications of the Astronomical Society of the Pacific calls attention to an interesting question in regard to the system of bright streaks on the moon, which radiate from the craters Tycho, Copernicus, Kepler, and others. These streaks, as he says, are well known objects, and are depicted upon the maps of the moon made by Lohrmann, Beer, and Maedler and Schmidt. Professor Holden offers to place at the disposal of any one who has the time to devote to the research, glass-positives of the moon taken with the great telescope. What is desired is to compare the photographs with the best maps to see if these bright streaks shift as the moon's age varies, or if they are fixed. Professor Holden's kind offer should be accepted by some one who has the time to give the subject careful consideration, as it is not at all difficult and only needs a good supply of patience.

Astronomy and Astro-Physics for May.

Astronomy and Astro-Physics for May contains some very interesting papers. Professor W. H. Pickering describes the mountain station of the Harvard College observatory at Arequipa, Peru, at an attitude of 8,055 feet above the sea. Professor Pickering states that a power of 1,140 on the 13-inch telescope has been used upon Venus in the daytime, that power showing the planet to a decidedly better advantage than 812. The phases of Jupiter's satellites are readily observed as they enter the shadow of the planet, a phenomenon very seldom seen in low altitudes. Professor Pickering sums up the advantages derived from his station in these words, "What we see here depends not, as elsewhere, upon the condition of the air, but only upon the size and quality of the telescope employed."

Mr. J. A. Brashear gives a sketch of the life of G. B. Clark, the great optician. Mr. T. J. J. See links together the history of the color of Sirius. Professor Barnard gives the result of his successful attempt to photograph Swift's comet. Mr. Monck writes on the Spectra and Proper Motion of Stars, and Professor Vogel, on the Motion of Nova Aurigæ in line of sight. Mr. Cortie has Some Recent Studies on the Solar Spectrum. Solar Photography at the Kenwood Astro-Physical Observatory is treated by Professor Hale, and Professor Pickering writes on The Nova in Aurigæ. Other interesting papers follow, besides news and notes of interest to astronomers. Professor Payne and Professor Hale have made a most interesting number in the one that is now before us, and we hope that their endeavors will not be abridged in the future.

IS IT DANGEROUS TO SPRAY FRUIT-TREES WITH SOLUTIONS OF POISONOUS SUBSTANCES IN ORDER TO PREVENT DEPREDATIONS FROM DESTRUCTIVE INSECTS?

THE following report of experiments made to determine the amount of copper and arsenic adhering to fruit that had been sprayed with Bordeaux mixture and other compounds is taken from Bulletin 17 of the Hatch Experiment Station of the Massachusetts Agricultural College at Amherst.

Grapes.

During the early autumn the Board of Health of New York City condemned several carloads of grapes as dangerous to the public health and ordered them destroyed, because they were slightly disfigured with the Bordeaux mixture which had been used by the growers to prevent mildew and rot. This caused a "scare" among the dealers and consumers and a serious fall in prices, which affected the market more or less for the rest of the season. To determine positively the amount of copper adhering to the grapes grown in the college vineyard, two lots of fruit, of ten pounds each, were selected, one from vines sprayed with the Bordeaux mixture throughout the season, and which were very badly disfigured, and the other from vines that were treated with the Bordeaux mixture up to the middle of June, then with two applications of the ammoniacal carbonate of copper, and which were not in the least disfigured.

An analysis of these two samples was made at the State Experiment Station. In the first, sample No. 1, there was found only $\frac{2}{1000}$ of 1 per cent of oxide of copper, an amount so small that one would need to eat from one-half to one ton of these grapes, stems, skins, and all, to obtain the least injurious effect, and that, notwithstanding the fact that the bunches were selected from those having the largest amount of the copper mixture adhering to them.

In sample No. 2 not a trace of copper could be found. It would seem from the above that, even under the most careless use of the copper solutions, no injurious effects need be feared, and that when properly applied there will not be a trace of copper left upon the fruit at harvesting.

Apples.

Early in December, the *Pall Mall Gazette* of London, England, published an article headed "American Apples. Alarming Allegations — Are They Doctored with Arsenic?" Then the statement is made "that American orchardists use arsenic in such large quantities to protect their fruit from insects as to completely saturate it, and that the bloom or white powder found on American apples is arsenic, brought to the surface by evaporation, and, if the fruit is eaten, this should be wiped off to avoid injurious effects. That the delicate, unnatural (?) bloom of the American apples is due to arsenic, a drug that is largely used by people, especially the fair sex in America, to make the complexion fair," and other statements equally absurd and without a shadow of foundation. These statements were undoubtedly made in the interest of speculators for the purpose of injuring the sale of American apples in the English market.

To determine the amount of copper and arsenic adhering to the surface of apples (for it could not have been absorbed into the substance of the fruit) which had been sprayed three times with the Bordeaux mixture and Paris-green, twenty apples, measuring one peck, were taken to the State Experiment Station for analysis. The amount of copper oxide found on these apples was twenty-two thousandths (.022) of one grain. This equals about five ten-thousandths (.0005) of one ounce to the barrel, or requiring two thousand barrels to yield one ounce of copper oxide. The specimens selected for this analysis were those with the roughest surface, to which would adhere more of the copper solution of Paris-green than to the average apples.

Not a trace of arsenic could be detected in this analysis, as Paris-green (average samples of Paris-green contain about thirty-three parts of oxide of copper and sixty-one parts of arsenious oxide) was not used after July 1, but it was probably all washed off during the three months following, before the apples were gathered, which was Oct. 1.

When we consider the fact that probably not one fruit-grower in one hundred throughout the country used Paris-green at all, and that not one barrel in thousands came from sprayed trees, the absurdity of the "scare" becomes still more apparent.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

The Ancestry of Chalicotherium.

CHALICOTHERIUM is a genus which appears in the lower Miocene simultaneously in Europe and America, where it has been very recently discovered. It extends into the Pliocene and then disappears. It has attracted unusual attention of late, owing to the discovery by Filhol and independently by Forsyth Major that the foot-bones of *Macrotherium*, which has been considered an Edentate, really belong to *Chalicotherium*. As the teeth are wholly different from those of the Edentates, and similar to those of the Ungulates, this genus represents a very aberrant and unique family.

The only known Ungulates which present a dentition at all similar are *Palæosyops* and *Meniscotherium*. The latter is from near the base of the Eocene, and last year in analyzing its dentition I found so many very striking resemblances to that of *Chalicotherium* that I was led to suggest that *Meniscotherium* might be the long-sought ancestral form, reserving final judgment until the feet were discovered. Marsh has very recently figured the feet of *Meniscotherium* (*Hyracops*), and, upon the whole, I think they sustain the supposition that the *Chalicotheriidæ* were derived from the *Meniscotheriidæ*. There are some profound differences, but these are mainly such as separate primitive from highly modified forms. The resemblances consist in the tridactylism of both genera and the marked similarity in tooth structure. I will discuss these points in more detail in the *American Naturalist* for June.

HENRY F. OSBORN.

New York, May 5.

Detection of Artificial Gems.

I WAS much interested in reading an article by Mr. W. G. Miller on the "Detection of Artificial (Imitation) Gems," that appeared in your issue of April 29. The writer states that, 1, hardness is no test for cut stones, because cutting softens the surface; 2, that specific gravity is no test in polished stones, because polishing affects the specific gravity, and because imitation-gem manufacturers made them with a specific gravity as near that of the real gem as possible; 3, that the examination of the optical properties of cut stones is difficult (and therefore presumably impracticable) because of the many facets; 4, that fusibility is the only reliable test. I desire to advert briefly; but first let me say that the title of the article, "The Detection of Artificial (Imitation) Gems," is misleading, and confounds two totally distinct things. *Artificial* gems, such as the rubies of Fremy or the emeralds of Hautefeille, are constitutionally identical with real gems, but are the product of a chemical process, and not the work of nature; whereas imitation gems, such as paste or glass or the so-called doublets, are gems only in appearance, consisting of two or three layers of quartz or garnet and one or more layers of glass of such intensity of color as to tone down or change the quartz or garnet to the red color of the ruby or the green color of the emerald or the blue of the sapphire, according as it is intended to counterfeit one or the other of these. The same confusion is also apparent in the statement that "the ancient Egyptians and Greeks were well versed in the manufacture of artificial stones." That they produced remarkable glass *imitations* is indisputable, — witness the marvellous collections of antique pastes in the museums of Europe, — but it is safe to say that the ancients never produced an *artificial* precious stone of any kind. So much for the title.

Now, second, as to hardness as a test, let me say that I differ entirely from Mr. Miller when he states that the hardness of a precious stone is reduced by cutting or polishing. The hardness is not affected in any way, and so far from cutting impairing the test for hardness it can in point of fact be more delicately given if made on cut and polished stones with properly prepared points made of the various gem minerals than when made on the rough uneven surfaces of uncut and natural minerals. That polishing reduces the hardness by *one-tenth* is ambiguous. Though in the Mohs scale of hardness the sapphire is placed at 9 and the diamond at 10, it would be more in keeping with fact when the abrasive quality or hardness of a diamond is considered to rate the diamond at 100 or even 1,000, so great is the difference between the two. Surely the writer does not mean to imply that, simply by polishing, the hardness of the diamond is reduced to 9 (the hardness of the sapphire), or that the sapphire is reduced to 8 (the hardness of topaz), or that topaz is reduced to 7 (the hardness of quartz). It is well known that *imitation* (not artificial) gems will scratch glass, and there is no reason why they should not. Their hardness is not even as great as that of feldspar, never that of quartz. Popular beliefs are not scientific facts, and it is a scientific fact that nothing but the natural edge of a diamond crystal will cut glass (frequently with very little visible scratching), but everything having the hardness of feldspar will scratch it, as well as glass itself. Popular errors are numerous, and these errors are frequently extensively copied. For instance, a statement appeared some years ago in one of our large magazines that if a precious stone could not be scratched by quartz it would surely be a diamond, and that any jeweller who would object to having a diamond tried with a file should be condemned as a fraud.

Polishing the surface of a precious stone can in no way affect its specific gravity if the stone is properly cleaned, and if the operator has a delicate balance and sufficient experience. In these circumstances it is surprising what exact results the various colors of the various precious stones give us. Further, I may say that, after visiting nearly all the known gem-cutting centres and the chief seats of the manufacture of imitation gems, I have never yet known of an instance where the manufacturer cared the slightest what the specific gravity of his product was, providing it had the desired color, or, if it were to imitate a diamond, it had a greater amount of brilliancy than the material made by one of his most successful competitors. The majority neither know nor care what the specific gravity of the gems is any more than does the regular jeweller.

As regards the optical properties of gems no mention is made of the dichroscope, with the use of which the facetting in no way interferes. The polariscope is also of considerable value. In fact, in the determination of rubies, sapphires, and emeralds, their pronounced optical properties, as shown by the dichroscope, or the polariscope and the spectroscope, together with their specific gravity and their hardness, which is so much greater than that of quartz, will readily distinguish them from everything "imitation." By means of the spectroscope we obtain the red band for the ruby, the absorption bands for the garnet, at D, E, and F in the spectrum, or the series of black absorption bands for the zircon. To distinguish glass from a real ruby requires but a glance; to detect the difference between rubies, spinels, garnets, and rubellite is not so easy, and in these cases fusibility is of no value.

I think the experience of those who have given attention to this matter is, first, that the specific gravity of the various precious stones is remarkably constant according to their color, seldom varying more than one in the second place of decimals, and, second, that the hardness of the gem is also remarkably constant, and that lines can be more clearly drawn in cut than in natural crystals, which are frequently not transparent, owing to impurities; namely, placing the sapphire at 9, the ruby at 8.8, the aquamarine at 8, and the emerald at 7.8.

I should not want to be responsible for the consequences if, at a jeweller's, anyone tried heating a gem in the flame of a spirit lamp or in the flame of a Bunsen burner, any more than I should if a buyer started to try a diamond with a file. Nor should I care to be responsible for the heating in a Bunsen burner of a fine ruby or sapphire, which frequently contains fluid-cavities, or of an emerald, which, if of a fine color, is seldom perfect, owing to internal striæ and fluid-cavities, or the topaz, which is affected by heat, and nearly always contains many minute fluid-cavities. The fusibility of the edges of the gems would not distinguish the artificial rubies of Fremy from those of the true ruby, as both are infusible. Nor would the test of heating in a Bunsen burner be practicable if Mr. Miller were called upon to examine in a few hours from one thousand to fifty thousand gems, and at the same time be perfectly sure that there were no imitation gems in the lot. Such testing needs the experience of the expert, who, before he opens a paper marked "blue or green aquamarine," can tell simply by the weight that the stone in the paper is a blue or green topaz, or who, if the stone is labelled "yellow topaz," can, without looking at it, but simply by the facility with which it slips through the fingers, determine that it is citrine (decolored smoky quartz) or the true mineral topaz; or who, if one hundred stones mounted as rings were placed before him in a tray, without supposing the presence of an imitation stone, could at once detect the single imitation present. Nor would fusibility be of any value in the examination of that class of imitations which are made by dipping heated quartz in green, red, or blue solutions, a common variety of which is known as Mount Blanc, or Alpine ruby.

Finally, few mountings which secure gems are improved by heating them to any extent, and generally the owners do not wish the settings disturbed. As to imitation diamonds there is surely not a jeweller worthy the name who cannot tell a true diamond from a paste one at the first glance, by its adamantine lustre. If it scratches sapphire he may be sure it is a diamond, whereas putting the gem into the flame would not distinguish the diamond from the white topaz or the white zircon or the white sapphire or the white tourmaline or any other white stone that is not fusible.

In conclusion, let me suggest to Mr. Miller the simple test for diamonds, of drawing the stone sharply over a piece of unpainted board in a dark room. Every diamond phosphoresces by friction.

GEORGE F. KUNZ.

New York, May 11.

Artificial Production of Variation in Types.

IN reply to your request for a few words on the question of artificial production of variations, as presented by Mr. West in *Science* of April 22, I may say that I quite agree with Mr. West in thinking that all attempts to produce new species by mutilations of the parents are foredoomed to failure. The idea that the embryo is in any sense a *reflected* image of the parent, and consequently that any particular loss or modification of an organ in the parent during adult life must impress itself upon the embryo, has not a shadow of a basis in embryology.

Mr. West asks, "Would it not seem the proper and only method to study the laws governing the modifications of the embryo?" If we substitute germ-cells for "embryo," the question may be answered affirmatively. If the question, as it stands, implies that modifications received during *embryonic* life, as the result of external influences, would be any more likely to repeat themselves in the next generation than if acquired during adult life, I should say that the assumption is entirely unwarranted.

The form and features of the adult are predetermined in the constitution of the germ-cell. No one denies that external conditions and influences may affect more or less the course of development; but the specific form of the adult is already settled in the germ before development begins. These are mere truisms in embryology.

C. O. WHITMAN.

Clark University, Worcester, Mass.

The "Hongote" Language.

IN a series of ten studies of South American Languages, principally from MS. sources, which I published in the last number of the Proceedings of the American Philosophical Society, one was partly devoted to the "Hongote" language, a vocabulary of which I found in a mass of documents in the British Museum stated to relate to Patagonia. I spoke of it as an independent stock, not related to other languages of that locality. In a letter just received from Dr. Franz Boas, he points out to me that this "Hongote" is certainly Salish, and must have been collected in the Straits of Fuca, on the north-west coast. How it came to be in the MSS. referred to, I cannot imagine, but I hasten to announce the correction as promptly as possible.

D. G. BRINTON, M.D.

Philadelphia, May 4.

AMONG THE PUBLISHERS.

THE number of the *American Journal of Psychology* which is about to appear will contain an article on the variations of the knee-jerk by Dr. Noyes, which contains the results of experiments on a case of dementia. Mr. Bolton contributes a digest of the experiments on memory made by Dr. Boas in the Worcester schools. Mr. Fraser shows the psychological origin of the *naive* realism of the unthinking man and of the philosophic realism of the Scottish school; both are due to a postulate of the sensations of touch as the ultimate realities. The old philosophers have before this served as subjects for clinical investigation or as "Versuchsthiere," but they have seldom been so correctly diagnosed as in Mr. Fraser's last two articles. The *Journal* continues its digests of psychological literature, to which it devotes much care. Such a careful review of the contributions to psychology in its various aspects by specialists in the various lines is believed to be presented by no other periodical; several of the most prominent names of specialists in America will appear as the editors of the different sections, e.g., Professor Donaldson (Nervous System), Professor Cattell (Association, Reaction), Professor Jastrow (Hypnotism), etc.

— The American Book Company have issued a new and revised edition of "Cathcart's Literary Reader," a book of selections from English literature which was first published under the editorship of George R. Cathcart some seventeen years ago. The selections are arranged in periods beginning with the age of Elizabeth and coming down to the present day. No attempt is made to give a complete compendium of English literature, only the leading authors, or those whom the compiler regards as such, being represented; but brief mention is made of many others and of their principal works, so that the volume will serve to a certain extent as an introduction to literary history. The writers of the nineteenth century are accorded the larger share of the space, on the ground that they are more interesting to us than those of earlier times, which is undoubtedly true; but we cannot think the editor's choice in all cases a judicious one. In the earlier periods he follows the general judgments of critics, giving prominence to those writers who are usually deemed the greatest; but in dealing with contemporaries, as he himself remarks, the guidance of established criticism is less available, and his choice, it seems to us, is not always to be commended. The selections in verse are far more numerous than their importance warrants; such verses as those of Poe on "The Bells" and many others that might be mentioned being unworthy of a place in such a collection; while, on the other hand, some of our greatest and most influential prose writers, including John Stuart Mill, John Henry Newman, and Matthew Arnold, are not represented at all. Nevertheless, there is much in the book that is valuable, and it is certainly superior to the ordinary "reading books," which may indeed teach the pupil to read, but which seldom teach anything of the history of literature or inspire a taste for literary excellence.

— The manuscript of Part II. of the "Index to the Literature of Explosives," by Charles E. Munroe, is now ready for printing, and, provided a sufficient number of subscriptions are obtained in advance to warrant doing so, it will be issued in pamphlet form, of approximately 150 octavo pages, at $1 per copy. Part I., issued in 1886, contains the titles of all articles relating in any way to explosives that appear in the *American Journal of Arts and Science*, 1819–1886; Philosophical Transactions of Royal Society, 1665–1882; Journal of Royal United Service Institution, 1857–1885; Proceedings U. S. Naval Institute, 1874–1885; *Revue D'Artillerie*,

CALENDAR OF SOCIETIES.

Philosophical Society, Washington.

May 7.—J. P. Iddings, On the Origin of Igneous Rocks; J. E. Watkins, John Stevens and his Sons, Early American Engineers; H. A. Hazen, Scientific Ballooning.

Appalachian Mountain Club, Boston.

May 11. — J. R. Edmands, Some New Paths and Camps on Mount Adams; W. M. Davis, The Relation of Mount Monadnock to Mount Tom.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

For sale or exchange, Das Ausland, 10 vols., 1882 to 1891, including 6 vols. bound, 4 in numbers. Wheeler Survey, vol. 1, Geog. Report; also vol. 6, Botany; Production of gold and silver in the United States, 1880, '1, '2, '3, '5; Selfridge Isthmus of Darien. Will sell at very low prices. J. F. James, 1443 Corcoran St., Washington, D. C.

For exchange.—A fine thirteen-keyed flute in leather covered case, for a photograph camera suitable for making lantern slides. Flute cost $27, and is nearly new. U. O. COX, Mankato, Minn.

To exchange; Experiment Station bulletins and reports for bulletins and reports not in my file. I will send list of what I have for exchange. P. H. ROLFS, Lake City, Florida.

Finished specimens of all colors of Vermont marble for fine fossils or crystals. Will be given only for valuable specimens because of the cost of polishing. GEO. W. PERRY, State Geologist, Rutland, Vt.

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To exchange Wright's "Ice Age in North America" and Le Conte's "Elements of Geology" (Copyright 1882) for "Darwinism," by A. R. Wallace, "Origin of Species," by Darwin, "Descent of Man," by Darwin, "Man's Place in Nature," Huxley, "Mental Evolution in Animals," by Romanes, "Pre-Adamites," by Winchell. No books wanted except latest editions, and books in good condition. C. S. Brown, Jr., Vanderbilt University, Nashville, Tenn.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

TRANSLATOR wanted to read German architectural works at sight (no writing). One familiar with technical terms desired. Address "A.," Box 149, New York Post Office.

WANTED.—A position in a manufacturing establishment by a manufacturing Chemist of inventive ability. Address M. W. B., care of *Science*, 874 Broadway, N. Y.

WANTED.—Books on Anatomy and Hypnotism. Will pay cash or give similar books in exchange. Also want medical battery and photo outfit. DR. ANDERSON, 182 State street, Chicago, Ill.

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A PROFESSORSHIP in Chemistry is wanted by one who has had five years' experience in that capacity. Would prefer to give instruction by lectures and experiments rather than by text-book methods. Would like a position in a college or university where there is a good student's laboratory. Special points of strength claimed are: (1) Thorough control of a class and good order during lectures and recitations. (2) Accuracy in experimenting with chemicals and skill in the manipulation of chemical apparatus. The permission of several distinguished educators has been given to refer to them if required. Would not care to accept a position paying less than $1,500. Address B. E., care of *Science*, 874 Broadway, New York.

ADDRESS WANTED.—Will some one please send the address of the Secretary of the American Philological Society. Also that of Herbert Spencer. "ADDISON," Room 84, 164 Madison St., Chicago, Ill.

ADDRESSES of Old Book Dealers wanted.—Wishing to obtain a number of old books out of print, I very much desire the addresses or catalogues of rare second-hand book dealers. If there is a directory or list of such dealers I should like to obtain possession of one. W. A. BLAKELY, Chicago, Ill.

1871–1884; H. M. Inspectors of Explosives Reports, 1873–1885. Part II. continues the Index for the above periodicals up to 1891, and contains the following in addition: *Dingler's Polytechnisches Journal*, 1820–1890; Proceedings American Chemical Society, 1879–1890; *Nicholson's Journal*, 1797–1813; *Popular Science Monthly*, 1871–1890; *Edinburgh Journal of Science*, 1824–1832; *Brande's Journal of Science*, 1816–1830. This index has been made by a careful search of each page of each of the 984 volumes included in it and is believed to be complete from the date of first issue of each of the periodicals named. Subscriptions should be sent to Charles E. Munroe, Torpedo Station, Newport, Rhode Island, U.S.A.

— Lord Randolph Churchill's account of his African journeys and adventures is to be published immediately by D. Appleton & Co. in a lavishly illustrated volume, entitled "Men, Mines, and Animals in South Africa." The book contains picturesque and humorous descriptions of scenes in the diamond-mines and gold-fields, of hunting in Bechuanaland and life in Mashonaland, and adventures with lions and elephants are interspersed among many characteristic comments upon people, manners, and customs, and practical resources. The book contains a portrait of the author, sixty-five illustrations, and a map.

— An article of especial value to teachers in the May number of the *Atlantic Monthly* is by James J. Greenough of Cambridge, a successful teacher in one of the most famous of the secondary schools in New England, which fit boys for Harvard, entitled "The Present Requirements for Admission to Harvard University." In this paper the writer speaks of the faults of the old system of entrance examinations and gives the history of the growth of the present system. He describes clearly the kind of instruction which is required to meet such examinations, in which the college requires each student who is admitted not only to have a large amount of useful knowledge, but at the same time to know how to use this knowledge to the best advantage.

QUERY.

Can any reader of *Science* cite a case of lightning stroke in which the dissipation of a small conductor (one-sixteenth of an inch in diameter, say,) has failed to protect between two horizontal planes passing through its upper and lower ends respectively? Plenty of cases have been found which show that when the conductor is dissipated the building is not injured to the extent explained (for many of these see volumes of Philosophical Transactions at the time when lightning was attracting the attention of the Royal Society), but not an exception is yet known, although this query has been published far and wide among electricians.

First inserted June 19. No response to date.

N. D. C. HODGES,

874 BROADWAY, NEW YORK.

TO THE READERS OF SCIENCE.

PUBLISHER'S ANNOUNCEMENT.

OUR PLANS.

WITHIN the past six months the use of *Science* by scientific men and women as a medium for prompt publication and weekly discussion, has increased very materially, so that the pages are now well filled each week with original matter. As the number of those promising contributions is increasing at the rate of three or four each day, it cannot be long before *Science* at its present size will be too small for the amount of matter offered. We have under consideration therefore an enlargement of the paper by one-half, but must first learn the temper of our constituency as to an advance in price to $5.00, which was the subscription price from the start for four years, up to June 30, 1887. Further, to carry out the proposed enlargement, we shall need five hundred additional subscribers. If you are not already a subscriber, are you willing to aid in making *Science* more worthy of American scientific work by becoming one?

It goes without saying, that the demand for scientific literature is limited, when compared with that for literature which is more to the public taste, so that the receipts of most of the Scientific Journals, in this country, do not pay quite for their printing and paper, to say nothing of the other items of expense. We say this merely to emphasize the fact, that generous and prompt support must be accorded this move if it is to succeed.

Titles of Some Articles Published in *Science* since Jan. 1, 1892.

Aboriginal North American Tea.
Actinism.
Amenhotep, King, the tomb of.
Anthropology, Current Notes on.
Arsenical Poisoning from Domestic Fabrics.
Anatomy, The Teaching of, to Advanced Medical Students.
Astronomical Notes.
Botanical Laboratory, A.
Brain, A Few Characteristics of the Avian.
Celts, The Question of the.
Collection of Objects Used in Worship.
Deaf, Higher Education of the.
Diphtheria, Tox-Albumin.
Etymology of two Iroquoian Compound Stems.
Eye-Habits.
Family Traits, Persistency of.
Fishes, The Distribution of.
Fossils, Notice of New Gigantic.
Grasses, Homoptera Injurious to.
"Healing, Divine."
Hemipterous Mouth, Structure of the.
Hypnotism among the Lower Animals.
Hypnotism, Traumatic.
Indian occupation of New York.
Influenza, Latest Details Concerning the Germs of.
Infant's Movements.
Inventors and Manufacturers, the American Association of.
Iowa Academy of Sciences.
Jargon, The Chinook.
Klamath Nation, Linguistics.
Lightning, The New Method of Protecting Buildings from.
Lissajou's Curves, Simple Apparatus for the Production of.
Maize Plant, Observations on the Growth and Chemical Composition of.
Mineral Discoveries, Some Recent, in the State of Washington.
Museums, The Support of.
Patent Office Building, The.
Pocket Gopher, Attempted Extermination of.
Psychological Laboratory in the University of Toronto.
Psychological Training, The Need of.
Rain-Making.
Rivers, Evolution of the Loup, in Nebraska.
Scientific Alliance, The.
Star, The New, in Auriga.
Storage of Storm-Waters on the Great Plains.
Teaching of Science.
Tiger, A New Sabre-Toothed, from Kansas.
Timber Trees of West Virginia.
Tracheæ of Insects, Structure of.
Vein-Formation, Valuable Experiments in.
Will, a Recent Analysis of.
Wind-Storms and Trees.
Wines, The Sophisticated French.
Zoology in the Public Schools of Washington, D. C.

Some of the Contributors to *Science* Since Jan. 1, 1892.

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