"The concept of number, in its simplest and original sense, is a fundamental concept. It is incapable of definition—that is, it cannot be exprest in terms of ideas simpler than itself."

This is not so; and if it were so, there would be no use in such a book. There is no possible account of the logic of number that is not based on the logic of relations, whether consciously or not; and number does not express a simple relation, whether the ordinal or the cardinal numbers are regarded as primitive. This has been made perfectly clear in more than one of the books with the titles of which the footnotes of this volume are ornamented.

On page 3 we meet with this: "*Axiom.* Any number is equal to itself." A poor sense of logic must a man have to entitle this an *axiom*, when on the page before he had said, "To {the idea of sameness between two numbers} we give the special name *equality*."

Whoever wishes to understand the logic of Integers should begin with Dedekind's little book, of which a translation is published by the Open Court Co. There is a good deal more to be read besides if one's appetite holds out.

**78 (28 April 1904) 328-330**

## THE NATIONAL ACADEMY MEETING

CSP, identification: Haskell, *Index to* The Nation. See also: Burks, *Bibliography; List of Articles;* MS L 159.257; MS 1480 (draft).

WASHINGTON, April 23, 1904.

The National Academy of Sciences has just concluded an unusually full and lively session here, beginning Tuesday, April 19. The focus of scientific interest, which for so many years burnt in the question of the origin of species, is now decidedly shifted to that of the constitution of matter, and to the partly logical discussions of the fundamental principles of physics. The papers of Tuesday belonged mostly to this field, where nothing is more interesting than the marvels connected with radium, polonium, actinium, uranium, and thorium, on the one hand, and those connected with helium, neon, argon, and xenon, on the other. Concerning the former series, Professor Barker gave some new information, in a paper whose special object seemed to be to introduce the excellent term "autoluminescence." What is called "phosphorescence" (not a very scientific term, according to our present conceptions) is mostly either an accompaniment of chemical change or a prolonged fluorescence; and the term "fluorescence," originally applied to cases in which light is absorbed while in place of it light of another wave-length, mostly blue, is emitted, is now sometimes extended to cases in which the light emitted has the same color as that absorbed. But the term "luminescence" has come in to denote the general property of emitting light with hardly any heat and without apparent chemical change. In 1896, Becquerel discovered that salts of uranium have a property which was afterwards found to consist in their separating the molecules of nitrogen of the air into their ions, or electrified atoms; and this property is called radio-activity. In 1898 the salts of thorium were found to possess the same pro-

perty. Mme. Curie ascertained, upon investigation, that different salts of uranium possess this property (which can be accurately measured by its electrical effects) in strict proportion to the amount of uranium they contain. Yet she found that pitch-blende, the ore of uranium, is much more radio-active than pure uranium itself. It must, therefore, contain some other radio-active substance; and by chemical analysis she partially separated from it in 1898 a new element more radio-active than uranium, which she called polonium. A little later she found in the same mineral another new element, vastly more radio-active, which she called radium; and an assistant of hers has found in the same mineral still another radio-active element, which he calls actinium. These five radio-active elements stand in Mendeléeff's table of the elements at the foot of as many columns.

In March, 1899, Mme. Curie announced that, in addition to its radio-activity, or power of ionizing the air, radium possesses a different property, that of shining eternally without any excitation; and it is this property of luminescence without excitation to which Professor Barker proposes to give the name of autoluminescence. There is no proportionality between radio-activity and autoluminescence. The former depends entirely upon the amount of the radio-active element that is present; but "autoluminescence" is one of those physical properties which seem to require the presence of a small amount of some second substance. Professor Barker, for example, showed one specimen of a salt of radium whose radio-activity is 240 times that of uranium; and it shone so brightly as to be visible all over the darkened, but not quite dark, hall. Yet another specimen of the same salt, so pure that its radio-activity is eighteen hundred thousand times that of uranium, will show no light in absolute darkness.

No other substance than radium was known to be autoluminescent until November last, when Becquerel announced that uranium, also, was slightly possessed of this property. A tube of radium in which careful examination by the spectroscope had discovered nothing else but air, was found, after some months, to contain a quantity of helium; and substances emitting helium have been repeatedly found to be radio-active. Thus, the waters of the Bath springs, which, after suffering the derision of generations, have come again into esteem, were first found to contain helium, and then to be radio-active. There is every reason to guess that any radio-active substance would have an effect upon the health; as in some instances is well known to be the case. Water both from an artesian well and from a lake has been found to be radio-active, and some men of authority believe that all bodies are more or less radio-active, and that the new gases of which helium heads the list are products of radio-activity. Professor Barker exhibited the first photographs printed from their negatives by the light of ionized nitrogen, and very perfect landscapes they were. He also showed a photograph of M. and Mme. Curie and their daughter Adéle, taken by the direct light of radium. It was a little fogged, proving the intensity of the effect to be too great for practical photography.

Dr. Barker's paper was followed by an account, by Dr. E. L. Nichols, of a research by him and Dr. Ernest Merritt into fluorescence spectra. The spectrum in all cases presented a single maximum of light, shading off equally upon its two sides, so as to remaind Professor Webster of the spectrum of an incadescent black

body, and to suggest an inquiry into the effect of temperature upon the position of the maximum. Three papers presented by Prof. John Trowbridge gave excessively condensed accounts of as many extensive researches made in his laboratory upon the spectra of gases; one by himself that has occupied seven years, one by Dr. Theodore Lyman (son of the biologist) that has occupied five years, and the third, of great merit and difficulty, by the young Californian physicist, Dr. H. W. Morse. It is very much to be regretted that only nine or ten hours are devoted at the Academy meetings to the reading of papers, so that only fifteen or twenty minutes, or half an hour at most, can be devoted to single reports of the most elaborate investigations; and numbers have to be gabbled off at a faster rate than the mind can follow them, although without the numbers no real understanding of physical and physiological researches can be had. Professor Trowbridge has employed a storage battery of twenty thousand cells, giving a spark of any length up to seven feet. His work was doubtless undertaken in the hope that facts would be brought out that might shed a light upon the constitution of matter, since the complexity of the spectrum of a gas (making due allowance for series of connected lines) cannot well be greater than that of the molecule that produces it. He finds that an electric current always acts to raise the vacuum, and thus tends to extinguish, and will ultimately extinguish, the light it produces. The hydrogen lines have a special tendency to disappear, and several phenomena go to show that hydrogen itself is an insulator, and that its apparent conductivity must be due to humidity. Professor Trowbridge declared himself to be quite assured by his own experiments, as well as by others, that the presence or absence of a line in the spectrum affords no indication whatever of a specially high temperature—a result very unfavorable to Lockyer's theory of "inorganic evolution," at least in its details. Dr. Lyman has been working upon the extreme ultra-violet part of the spectra of hydrogen and other gases, to which one millimetre's thickness of atmospheric air is absolutely opaque. Hitherto, one experimenter alone has ever succeeded in photographing these lines (the only way of observing light to which the eye is entirely impervious, even if the retina be sensitive to it). But Dr. Lyman has accurately measured the wave-lengths of the extremest lines which seem to exist, to 1,050 Ångström units—a feat that had been deemed impossible. Dr. Morse, with a most ingenious instrument, has photographed spectra of a Wehnelt interrupter. As an incidental result, he obtained in one photograph a flame-spectrum, an arc-spectrum, and a spark-spectrum; so that it would appear that these three kinds of spectrum may be produced by gas of the same temperature.

The only other papers of Tuesday were two, of characteristic ingenuity, by Professor Woodward, in one of which he proposed a peculiar form of pendulum for the absolute measurement of gravity, while the other gave a calculation from which it appeared that the effect of doubling the pressure of the atmosphere would be to diminish the radius of the earth by about 2 metres.

On Wednesday, the Academy received the sensation of the session in a report by Professor Chittenden of Yale on the results of his experiments upon the effects of reducing the amount of food, especially proteids, or nitrogenous food, to less than half what men ordinarily take. He began by rehearsing all the various

dietary standards now ordinarily adopted, of which the best known is that of Voigt, who prescribes 118 grammes of proteids daily. Some go somewhat below this figure, others rise far above it. A Swedish standard calls for 189 grammes of proteids in daily food having a heat of combustion of 4,728 large calories. Atwater's American rule is 125 grammes of proteids with 2,500 calories for a man performing severe labor. But Mr. Fletcher has subsisted for many years upon half the proteids of Voigt's standard, with half the fuel value, and has remained all the time in most admirable condition. Now it seemed to Professor Chittenden that the various dietary standards merely show what men are in the habit of eating, and do not at all prove that they might not enjoy greater vigor if they ate less. In order to test the question, he experimented for six months upon twenty-seven men, of whom six were professors and instructors in Yale, thirteen were soldiers under military discipline, and eight were athletic students of Yale. Nothing was absolutely prescribed; there was no weighing out of the food except for the soldiers; but the men were desired in the course of a fortnight gradually to reduce the amount eaten, especially in the morning, so as to bring it down to about half of what it had been. It was, as Professor Chittenden expressed it, not prohibition, but temperance.

He began with himself in November, 1902, when he was a small man eating about Voigt's standard. In a few weeks, he reduced the amount by one-half; and after nine months his body weight had begun to be stationary. He then found that during six months his kidneys carried away 5.82 grammes of nitrogen a day, in place of the 16 grammes that they would have excreted under Voigt's standard. (It will be understood that the nitrogen so carried away is precisely the nitrogen that has been absorbed, the metabolic nitrogen, and is therefore the most important fact.) His health and efficiency seemed to be improved. Similar results were detailed for the other men of the first group. The thirteen soldiers were at first casting off on the average daily 16 grammes of metabolic nitrogen. After reducing their food in the course of a month, during the next five months the amount of 16 grammes was reduced to an average of 7.80 grammes. At the end of that time they had greatly gained in strength and courage, without any complaints of insufficient food. There was no change in their reaction-time nor in the blood, unless there had been a slight increase in the number of red corpuscles. The fullest possible data for each man were given in detail in the report. All the men of the third group were enthusiastic as to the good effect of the reduced ration.

Professor Chittenden entitled his paper "a preliminary report," and confined himself strictly to the facts observed and to the scientific conclusions from them, without indulging in any opinions as to what might be the ultimate consequences of the meagre diet. But the facts spoke for themselves, and undoubtedly produced a great effect upon the minds of all his nonmedical auditors. Dr. Bowditch thought that they showed that the *optimum* of diet was nearer the minimum of nitrogen equilibrium than the maximum. He thought the digestive organs might under such a diet undergo a partial atrophy, and he would like to know whether the temperature of the skin would not be lowered, since otherwise it was difficult to understand how the heat of the body could be maintained when the fuel value of the food was so much reduced. Two other medical members of the Academy indulged their

professional propensity to enunciate opinions in the customary highly impressive medical tone, one of them drawing a lesson altogether destructive of Professor Chittenden's facts from the feebleness of the Hindus, who subsist upon rice, while the other pronounced an equally magisterial dissent, grounded somehow upon the extraordinary strength, activity, and endurance of the Japanese, who subsist upon rice. There were other comments which showed mainly how surprising Dr. Chittenden's facts appeared to be to many members.

A paper by Dr. Horatio C. Wood, jr., read by his father, related to the drug Canadian hemp (*Apocinum cannabinum*), whose effects resemble those of digitalis. Professor Osborn, in the name of Dr. W. D. Matthew, gave an interesting account of the arduous studies that had been found requisite in order properly to set up the skeleton of a great sauropodous dinosaur, a reptile quadruped sixty-five feet long.

The papers of Thursday were of various sorts. The most remarkable was a discussion by Gen. Abbot of the disposition of rainfall in the basin of the Chagres River, with a view to estimating the force of the objections that have been raised to the plan of establishing artificial lakes in connection with the Panama Canal. For this purpose it becomes necessary to ascertain how much water percolates through the ground. By remarkably ingenious and solid reasoning, based upon the average monthly rainfall, evaporation, and discharge of the streams, with other data, the monthly state of the ground water was deduced, and it was shown that no danger is to be apprehended from the projected lakes. Professor Osborn gave some account of the recent palæontological discoveries of the American Museum of Natural History's exploring parties, which amount to a complete palæontological survey of the West. From this has resulted the overthrow of Clarence King's theory of a vast lake having formerly existed in that region, in which the animals whose remains are found perished. Moreover, it appears that, throughout the tertiary period, Europe, Asia, and North America formed a single zoölogical region. Professor Osborn argued not only that North and South America were connected by a bridge in the pleistocene, but that there was strong evidence of an earlier bridge during the cretaceous period. (Professor Agassiz, however, thought the evidence of this quite insufficient.) A fully developed armadillo had been found in Wyoming, and the edentates seemed to be as old in North as in South America. An animal resembling a crocodile had been exhumed in Montana. Three, and possibly four, collateral lines of horses had been clearly made out in the miocene, with very perfect specimens. Another paper by Professor Osborn related to the classification of reptiles. He argued that there were two grand divisions of these animals, which had been separated since the Permian age. One of these was characterized by having only one skull-arch, while the other had two. From the latter are descended all our present reptiles and also the birds. From the former, which was much more conservative in its evolution, were, nevertheless, descended the mammals and man, as well as the tortoises. This paper provoked no little discussion, but the value of the work was acknowledged on all hands.

Prof. A. T. Zahm, introduced by Mr. Alexander Graham Bell, gave an account of experiments for determining the law of the friction of the air at speeds below

40 feet per second. The experiments were well conducted, and led to a very valuable and simple formula, with which they accord remarkably well. Mr. Graham Bell gave an interesting account of his breed of multinippled sheep on his estate of Beinn Bhreagh. Mr. C. S. Peirce read a paper on the simplest possible branch of mathematics. A paper by Professor Newcomb on the application of new statistical methods to the question of the causes influencing sex, was announced, but was not read. On the whole, the session illustrated the progress of science in this country, for more than half a dozen of the papers were memoirs of high importance; which would hardly have happened ten years ago.

**78 (28 April 1904) 335-336**

## COMTE'S PHILOSOPHY

**The Philosophy of Auguste Comte.**

By L. Lévy-Bruhl. Authorized translation [by Kathleen de Beaumont-Klein]. With an Introduction by Frederic Harrison. G. P. Putnam's Sons. 1903. 8vo, pp. 363.

CSP, identification: Haskell, *Index to* The Nation. See also: Burks, *Bibliography; List of Articles;* MSS L 159.243, L 159.247.

Throughout the greater part of the sixth decade of the nineteenth century, there seemed to be some prospect—to many of those who were then laboring to render philosophy, and especially logic, exact and scientific, it appeared as a danger—that the philosophy of Comte, or the first section of it, might become as dominant as nominalism has been since the overthrow of scholasticism. This was feared, not so much because that philosophy was a tissue of contradictions from beginning to end, as because, while teaching the relative, temporary, partially false character of all human knowledge, expressly including the Positive Philosophy itself, nevertheless the very essence and soul of it lay in a recommendation not to pursue certain lines of inquiry, and in a disposition to bring brute force to bear to prevent those inquiries from being pursued. That was the very stamp of Comte. That was his catholicism. Nor were these prohibitions the result of long examination anxiously attentive to all that could be urged on both sides. They sprang, on the contrary, from just such one-sided thought and partisan blindness as produced the revocation of the edict of Nantes and other events of French history. While such a terrible danger was hanging over human science, those who felt it to be such were naturally unwilling to say anything that might be taken for an approval of Comtism. But now that that system is utterly exploded, and that it seems impossible that—in this country or in England, at least, where the sacredness of individualism is felt—there ever should arise any real danger to inquiry from inquiry itself, it is time to apply ourselves to learning what there is to be learned from the many pregnant suggestions of that extraordinary thinker.

France, during the nineteenth century, produced no philosophical ideas of greater value than Comte's law of the three stages of thought and his classification of the sciences. There was an obscure Dr. Charles Burdin, who died, we believe,