SCIENCE

NEW YORK, AUGUST 28, 1891.

ALCHEMY.[1]

WHEN I announce alchemy as the subject of my address, a word of apology is due for selecting a subject so outgrown and alien to the spirit of the age. It is not to revive the wild theories and chimerical hopes of the past that alchemy is brought before you at this hour. Yet it is always interesting to trace the evolution of a science, and to note its unfolding and progressive development, like the breaking of the morning. The dawn reveals wild shapes and distorted forms, the shadows of sunrise stretch out limitless, but with the onward sweep toward full day, portentous forms and endless shadows settle down to the safe and quiet realities of every-day life. So the wild dreams of that dawn of science have subsided into the assured facts of chemical science. Alchemy is often called the forerunner of chemistry, and out of its broken columns there has been built up the enduring temple of chemical science. No science has a more enduring basis of known facts than chemistry, and none can more calmly examine the basic principles upon which it is built without fear that the foundation stones will turn to dust upon the touch of investigation.

But no science comes to us like Minerva leaping from the brain of Jupiter,— "adult and full armed," — possibly because Jupiters are so rare, and the bold surgery of Vulcan so seldom invoked. The passage from alchemy to chemistry is full of suggestions, and has often been considered, but usually by contrast rather than comparison. One filled the world with vast hopes but unsatisfied longings; the other has crowned the race with benefactions. Yet the results of the labors and discoveries of the alchemists have been of great value to the world, even though the direct objects they sought forever eluded their grasp and left disappointment and despair to their votaries. More than a hundred years ago Harris tersely described alchemy, "Ars sine arte, cujus principium est mentiri, medium laborare, et finis mendicare," — the art without art, whose beginning is to lie, the middle to toil, and the end to beg.

We are prone to look back upon this nebulous science with disdain as the product of an age that had full confidence in magic and sorcery, that could accept without hesitation the elusive nature of matter, yet find no difficulty in the belief in the resistless power of occult forces. But let us be candid even in our review of ancient error. Let us see what were the hopes and aspirations of these hermits of science, and see how modern thought stands related to ancient dreams — whether we find in scientific thought, the same as in matter, a tendency to move in recurring cycles.

The objective points of the alchemists were:

1. *The Elixir of Life*, panacea, all-cure, a substance which would confer quasi-immortality upon any one who should swallow it, curing all sickness, assuaging all pain, and transforming hoary age into blooming youth. It was even more eagerly sought than the transmutation of metals. Life is the highest gift, and without it all other blessings turn to ashes. "All that man hath will he give for his life." But the crowning of life is health. It is not wonderful therefore that men in all ages have sought under various names the elixir of life.

The alchemists regarded gold as the king of metals, and its symbol was the sun — the giver of light and life. When the Spaniards discovered such astonishing quantities of gold in America, they were confident that some form of the elixir of life was hidden away somewhere in the mysterious continent, and many parties were formed to explore its solitudes in quest of this great gift. For this, Ponce de Leon and his faithful band pierced the swamps of Florida, seeking "the fountain of youth," where their leader was wounded to his death. But these were only the vanguards of a countless host that is still marching on.

The alchemists regarded gold as the most perfect form of matter; unalterable by fire, incorrodible by air, water, or any simple acid. Its very insolubility was proof of its excellence. This perfection of matter must be able to impart its properties to perishable forms of matter, and "potable gold" was supposed to be the elixir of life.

Roger Bacon was convinced that auric chloride was this elixir, and he informed Pope Nicholas IV. of the case of an old farmer in Sicily who ploughed up a golden vial containing a yellow liquid, which he swallowed supposing it to be dew, whereupon he was transformed into a vigorous youth.

Others sought the elixir as an essence derived from the distillation of a great number of substances, while the Hindoos supposed the Amreeta was obtained by churning the sea with a mountain.

We smile with superior air at such fantastic imaginings, yet not long ago the world went wild over Brown-Sequard's elixir of life,— extract of mutton.

2. *The Alcahest.* — The alchemists searched for some substance that would dissolve all other substances — alcahest, or universal solvent. Crookes forcibly suggests that this is found in fluorine.

3. *The Philosopher's Stone*, having the same purifying and ennobling office for mineral matter that the elixir of life would have on animal forms. By means of this substance they could effect the transmutation of base metals into perfect metals, "curing them of their sickness and perfecting their nature," thus changing copper to gold and lead to silver, performing "the great work" by projection of the philosopher's stone on base metals in presence of great heat.

Such were the dreams, the hopes, and the endeavors of the alchemists — life prolonged at pleasure, health perennial, wealth beyond measure. It was a great hope, and it was slow to die. The things sought are indissolubly interlinked with the desires if not the expectations of humanity. Nothing debasing entered into this scheme, but rather the aim was to ennoble man and matter, and out of base material to bring forth the flower and fruit of perfection. To a degree, man would become a creator, and a semblance of omnipotence would be placed in the hands of mortals, not merely

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by linking himself with the powers of nature and clothing himself with their immeasurable might, but by subduing these forces and compelling them to surrender their secrets and do his bidding. By torture nature could be taught to obey, and become the slave of her mortal child, and the crucible became the instrument and symbol of this power.

If the hope of such mastery and of victory laden with so rich spoils were held out to the children of the nineteenth century would they exhibit a superiority to the visionaries of the thirteenth century? It was the gambling spirit of the olden time, and man sought to use loaded dice in his game with nature.

Consider, also, how slowly the dreams of alchemy have given place to the wide-awake facts of chemistry. The great Napoleon, during his campaign in Egypt, sought initiation into the dark mysteries of Egyptian secret art. Napoleon III., before he ascended the French throne, had in his service those who attempted the transmutation of baser metals into gold. Dumas thought gold might be an allotropic form of copper, and silver allotropic lead; and Sir Humphrey Davy told the elder D'Israeli that he did not consider the undiscovered art of transmutation an impossible thing.

About three years ago, in a neighboring city, an alchemist exhibited to a leading business man his ability to multiply gold by heating a gold coin with the philosopher's stone in a crucible, and removing from the crucible a mass of gold weighing three times as much as the original coin. Other business men witnessed a similar operation, and became so fully convinced of his power to increase the amount of gold threefold that they formed a company to multiply gold by digestion with the philosopher's stone. Gold coin to the amount of ninety thousand dollars was placed in an iron digestion vat with a quantity of the philosopher's stone. The vat was placed over a fire in a furnace built for the purpose, an iron lid placed over the vat, and securely locked, the furnace-room locked, and all the keys placed in the hands of the gold-multiplying company (unlimited), with strict orders that the vat must not be opened under three weeks. The alchemist having been called away on business to another city, and not returning at the appointed time, the gold company became suspicious and opened the vat, only to find the gold gone, and some stones and scrap iron in its place. It was the *gold* that had been transmuted.

A few months ago the same sharper was arrested in London for attempting a similar fraud, and when arraigned in the criminal court the police magistrate said "it was just possible that Pinter might have discovered some method of increasing the weight of gold." Among the victims of Pinter's philosopher's stone, a member of the house of Rothschild's and of Baring Brothers are mentioned. Who shall say that faith in "the great work" has left the earth? A few days ago at the Old Bailey he was sent to prison for swindling.

The ancients, arguing from analogy, supposed that metals grew like vegetables, only the growth was subterranean; and there was a vain search for the seeds of metals. Foiled in this quest, they thought that metals passed upward by successive development by a sort of evolution, the base metals being progressively changed to those of a higher order till perfect metal such as gold was formed. A third conception was that metals are composite, made up of some basic matter or earth, and phlogiston. The notion of the composite character of a metal was perhaps the most damaging error of the alchemists. With them a metal was not a simple body, but the union of an earth with an inflammable matter; that the metalline character resided in the phlogiston rather than in the earth; that the greater the quantity of phlogiston combined with the earth the more perfect was the metalline character brought out, and if we could combine enough phlogiston with any earthy body we could form metals even of the most perfect character. Even Macquer, in his dictionary of chemistry (1776), is in doubt whether the kind of earth determines the character of the metal to be formed by adding phlogiston, and whether the real difficulty did not lie in securing sufficient phlogistication of intractable earths.

The perfect metal, gold, was considered to have an oily or unctuous quality, and the fact that oils contained a large amount of phlogiston was considered significant. To secure the oily quality of a perfect metal, oils were favorite sources of phlogiston; and it was claimed that if intractable earths were fused with oil in an accurately closed vessel, perfect metals could be secured. Nor was this mere theory. Beccher proposed to the States General to procure gold from any kind of sand, and claimed to demonstrate the same by his famous experiment of *Minera arenaria perpetua*, building his house on the sand very literally. So Beccher and Geoffroy proposed to obtain iron from all clays by heating them with linseed oil in close vessels.

The alchemists reasoned that if phlogiston were accepted as the metalliferous principle, the combination of which with any earth would convert it into a metal, and the escape of which would reduce any metal to an earth, then the transmutation of one metal into another metal would seem no more difficult than the transformation of earths into metals.

The phlogistic theory of Beccher and Stahl was considered a great advance in its day because it enabled the chemist to classify all the then known facts of chemistry. But it soon became a bar to scientific progress, and with its overthrow a new era dawned in science.

The change of a metal into another metal was not a mere theory with the alchemists, they saw repeated proofs of this transmutation. By the purifying influence of fire they made purest silver out of unquestionable lead, and the silver medals attesting this fact which Dr. Bolton lately found in Austria were the *ecce signum* of the alchemists. The Chinese still hold that lead kept in fusion for two hundred years becomes silver, and silver similarly treated changes to gold. What the alchemists required was some means to quickly transmute the whole of the lead into silver and prevent the large loss of lead when fire alone was used. The truth wrongly interpreted only led them widely astray.

The conception also of the instability of the properties of matter — that, for example, color, lustre, weight, malleability, fixedness in the fire, etc., are properties that may be imparted to a body destitute of them, irrespective of the nature of such body, just as a man may change his clothes without changing his person — was most misleading for the alchemists. "If the property is separate from the substance, like our apparel, let us clothe copper with the properties of gold and thus make it gold." The theory of the instability of matter was the quicksand that swallowed up scientific progress for the alchemists.

The indestructibility of matter, and the possibility of recovering a given substance notwithstanding all its disguises by combination with other bodies, — the persistence of matter and the immanence of its properties, — were grand discoveries in material science. They marked the transition from alchemy to chemistry. The recognition of the indestructibility of force was the second great step, the crowning discovery of modern physics. In the words of Faraday, "It is the highest law in physical science which our faculties permit us to perceive."

Shall we take a third step and proclaim the permanence of force but the destructibility of matter,— that the atom may have a life, grow old, and die, or pass back into primitive no-thing-ness, or become the ether of which we talk so much and know so little? Shall we assume that radiant force may be changed into matter and fall under the law of gravitation?

No single thought has contributed so much to give form and permanence to chemical science as the atom of Dalton. An atomic theory was indeed held by the Greeks in regard to the constitution of matter, but it related chiefly to the question of the continuity or discontinuity of matter in mass, and considered the question of the limited or unlimited divisibility of matter. But the chemical atom, with its application in explaining the law of definite and of multiple proportions by weight in chemical combinations, was the gift of the Quaker schoolmaster of Birmingham. It has furnished not merely a basis for nomenclature and notation, but has given form and substance to chemical science. Like a sentinel rock, it lifts its immovable form amid the shifting waves and tides of chemical theories. Shall the chemical atom finally be relegated to the limbo of exploded theories and creeds outgrown? The question is perhaps nearer our doors than we had suspected.

The question has been seriously raised by an eminent American chemist whether gold can be manufactured. On the affirmative side of this question he points to the fact that didymium has been split into two metals, and by recombining these two new metals the old didymium was again formed. He also points out the complex nature of yttrium as shown by Crookes by means of the spectroscope, and then proceeds to say: "These facts, and many others that could be given, make it probable that the so-called chemical elements are not really elements, but compounds, which in time we shall be able to separate into their constituents, and conversely to reproduce by combining other substances. Among the heavy elements — and hence those that would be expected to yield to the searching attacks of the chemist — is gold. It is not improbable that in time it will become possible to make gold in large quantities — an event which would throw it out of use as a standard of value, so far as it derives its own value from its rarity" (North American Review, Sept., 1890, p. 377).

At first sight this might appear to be a chemical canard, but the writer proceeds to point out the social and financial results of cheapening of gold.

The statement that didymium is a compound metal is of great interest to the chemist. But the fact that the reunion of these metals will form the old metal or alloy is not so surprising, but is what any chemist would expect. But how do such facts show the probability or even possibility of making any given metal out of heterogeneous materials? If the combination of cerium and samarium would form didymium then a plausible case would be made out. But if praseodymium and neodymium are required to make didymium, how are we nearer the manufacture of this last metal by such discovery? We must still have the two new metals to make the old metal. Suppose that gold can be split into two or ten new metals, the reunion of which will form gold, does this bring us one whit nearer the new age of gold? If it takes gold to make gold, what part or lot have baser metals in such transformations?

The trend of recent discoveries is to increase the number of simple or elementary substances. The simple nature of any substance has only been held provisionally, regarded as elementary until its compound nature is shown by exhibiting the separate elements of which it is composed. The more recondite the appliances for investigation, the more complete the differentiation of matter, the greater will be the number of elementary substances, and yet we will be as far as ever from the ability to change one metal to another.

The question of the primary and essential nature of matter belongs to metaphysics rather than physics. Yet the nature of matter as well as its properties is a vital question in chemistry. The chemist has made certain basic propositions the foundation of his science. The essential immutability of matter is a corner-stone. Weight and measure have no place in a science that deals with matter essentially variable in its nature, but it is weight and measure that have made chemistry the most exact of all natural sciences.

The idea of an original simple matter as the basis from which all things have been formed is not wholly modern. Duns Scotus advanced the idea that the basis of universal existence was a *materia primo-prima*, by the differentiation of which the individual is formed. About twenty-five years ago a modified form of this theory was brought forward by Professor Hinrichs of Iowa, who advanced his theory of "pantogen" or "urstoff" to explain the constitution of matter. There was only one simple or elementary matter, urstoff; and as all forms of matter are produced from this primary matter, he called it "pantogen," and the products formed by the reduplication of this simple matter he called "panatoms." His argument was based upon a parallelism between astronomy and chemistry: "The basis of this celestial mechanics (astronomy) is only a hypothesis, that of universal gravitation, which essentially consists in the affirmation that the heavenly bodies only differ in regard to the amount or quantity of matter. Let us have the boldness to pronounce a similar hypothesis in regard to chemical atoms. Let us suppose that the atoms of the different elements only differ in regard to quantity, that is, in regard to the number and relative position of the atoms of some one primary matter, just as the planets only differ according to the number of kilograms of ponderable matter they contain and its distribution around their axes. Since everything would be composed of this one primary matter we call it pantogen, and its atoms panatoms,"

This programme of atomechanics was caustically reviewed in the *Chemical News*, December, 1867, which pointed out the fact that Professor Hinrichs, like all discoverers of his class, continually falls back on analogy. "This too free use of analogy has been the bane of science from the time of Plato, and it would appear that the race of speculators who mistake fanciful analogies for fundamental scientific laws is by no means yet extinct."

The reviewer closes by urging Professor Hinrichs, as the crowning feat of his discovery, and that which would compel the adhesion of scientific men to the new theory, "to isolate pantogen." Has the whirligig of time brought the keen editor and sharp reviewer around to face urstoff and panatoms?

How was the atom formed? Was it coeval with matter, or did matter antedate the atom? Was there *prima materia* — pantogen, protyle, urstoff — out of which the atom was formed by reduplication of urstoff upon itself? Do heredity, selection, environment, and discriminative destruction explain atomic formation, and the discrimination of atom from atom in the domain of chemistry? "A theory of evolution of this kind," says Clerk Maxwell, "cannot be applied to the case of molecules, for the individual molecules neither are born nor die; they have neither parents nor offspring; and so far from being modified by their environment, we find that two molecules of the same kind, say of hydrogen, have the same properties, though one has been compounded with carbon and buried in the earth as coal for untold ages, while the other has been occluded in the iron of a meteorite, and after unknown wanderings in the heavens has at last fallen into the hands of some terrestrial chemist."

When we attempt to apply the process of discriminative destruction the trouble increases, for "we should have to account for the disappearance of all the molecules which did not fall under one of the very limited number of kinds known to us; and to get rid of a number of indestructible bodies exceeding by far the number of the molecules of all the recognized kinds, would be one of the severest labors ever proposed to a cosmogonist." The "missing links" would form the principal chain.

But Mr. Crookes finds, by means of an interpretative illustration of the periodic law, an explanation of the formation of matter out of protyle with segregation into atoms of definite valence and proximate molecular weight.

The discovery of the periodic law of chemical elements was a long stride in scientific progress. It bids fair to be as masterful in chemistry as universal gravitation in astronomy, and a certain analogy may be traced between them. The planets have certain orbits around the sun, and velocities of revolution proportional to their mass Did position fix their mass, or mass determine their position? By the periodic law, the atom having a certain mass or weight falls into a certain position. Is the mass of an atom determined by its position, and not rather the position determined by its mass? Does the periodic law require us to consider the properties of matter as mathematical functions of numbers, and thus reproduce the Pythagorean philosophy of number and harmony, that "all things are number, and that number is the essence of everything — the elements of numbers are the elements of existence." Or have position and force acquired the properties of matter?

If there was ever a flank movement on Nature by which she has been compelled to surrender a part of her secrets it was the discovery of the spectroscope, "which enables us to peer into the very heart of nature." It is the "Open sesame" of physics and chemistry. If biology could lay its hands on a similar instrument to unlock the secrets of life, what fields of discovery would unfold before the explorer!

By means of the spectroscope we may question the very elements and submit them to cross-examination in the court of science. Surprising results have thus been reached, but the trend seems to be all in one direction, to show the complex nature of what was supposed to be simple matter, that didymium, e.g., was not a simple body, but contained at least two metals, was twin in more senses than one. It was much the same as Davy's showing that potash was not a simple body, anomalous among chemical substances, but contained a metal, and thus fell into line in chemical combinations. But does the discovery of even a nest full of metals where only yttrium was supposed to be require the assumption of meta-metals, stuff which has not yet grown to the full measure of a metal; shall we suppose that each *ultissimum elementum* has only one line in the spectrum, and that the spectroscope will yet reveal swarms of meta-metals in the chemical system, just as the telescope calls out the countless stars from the Milky Way?

On the other hand, does the splitting up of the rare metals justify the assumption that the metals most fixed in character, and which show no tendency to split into meta-metals, such as gold and platinum, are compound in constitution and may be compounded out of baser materials? Crookes's suggestion that what comes to us as copper has been shunted on to the wrong track in its passage from aboriginal elemental matter to make gold, holds out small hope to metallic transmutation.

In the use of the scientific imagination few men can compare with the editor of the *Chemical News*. Let us briefly follow Mr. Crookes in his scheme of the genesis of the elements out of ante-elemental material,— protyle, urstoff, immaterial matter, out of which matter may be formed by a process of condensation through the cooling down of the original fire-mist until it acquires elemental properties. By a process of polymerization of protyle, or reduplication of dissociated matter, with fall of temperature and acquisition of different amounts of electricity, he supposes the elements are evolved as known to us. Assuming the periodic law of Newlands and Mendeleeff, he pictures to the mind how the elements may have been formed out of matter in the ultra-gaseous condition by cooling down below the temperature of elemental dissociation, when out of the swarming myriads of ultra-elemental matter the elements may group into knots at nodal points. Around a central line, electrically, magnetically, and chemically neutral, the length of the line marking the fall of cosmic temperature, the mighty gravitative force swings like a pendulum, but with lemniscate motion through space of three dimensions, and thus the atoms are formed and the elements appear, from hydrogen to uranium. The outward swing gives the electro-positive elements; the inward swing forms the electro-negative, the degree of electrization determines the atomicity, and the position on the left or right of the neutral line determines the magnetic quality — paramagnetic or diamagnetic.

Such a scheme of the genesis of the elements fires the imagination with the loftiest conceptions, so many things fall into line and order. The very hiding place of missing elements seems to be pointed out, and newly discovered metals fall into their fore-ordained place prepared for them before the foundation of the worlds. It would seem presumptuous to question a theory so beautiful and satisfying, but its foundations are assumptions of a sweeping character. If we concede the existence of matter without the properties of matter, we have yet to learn how it can acquire the properties of matter. If we concede that it is ultra-material because of heat, how can it part with heat before it acquires radiant power, a property of matter? We might also be tempted to inquire, what has become of the heat which once held the universe in the ultra gaseous condition?

Nor is the theory of the successive formation of elementary atoms, with their progressive increase of atomic weight by reason of the fall of temperature below the point of elemental dissociation, entirely satisfactory. It is claimed that hydrogen and then lithium first appear in the elemental condensation, because with them the diminution of temperature at which elemental dissociation ceases is reached first of all, the heat being still too great for other bodies to exist even as elements. The heavy metals, such as platinum and gold, with large atomic weight, are formed later in time, because a vast reduction of cosmic heat was necessary before dissociation would cease and elemental consociation become possible. Do platinum and gold give indications of a tendency to dissociation more marked than that of lithium when questioned by heat, electricity, and chemical action, or even when cross-examined by the spectroscope? Does not gold exhibit an integrity worthy of a noble nature? Does it hold out to alchemy the most distant hint of a multiple nature by means of which she may hope to divide and conquer?

The hypothesis of the evolution of the chemical atoms by aggregation or polymerization of one matter substance challenges scientific thought. Based upon broad assumptions and sustained entirely by analogy, it will hardly disturb the relative coinage value of the metals by holding out hopes of alchemic transmutation. The advice of Mr. Crookes to treat it simply as a provisional hypothesis is conservative and wise.

NOTES AND NEWS.

TO MEET the desire for instruction in the modern branches of astronomy, which have been so wonderfully developed in the last few years, a post-graduate course in astronomy and astro-physics, open to a limited number of students, has been established at the Western University of Pennsylvania. Exceptional facilities for such a course are afforded by the library and apparatus of the Allegheny observatory. Instruction will be given by means of lectures, recitations, and examinations, and by the practical use of instruments in observation and measurement. A knowledge of mathematics equivalent to that given in the undergraduate department of the university is requisite for admission to the course, which will extend over a term of two years. Further information may be had of Dr. W. J. Holland, chancellor of the university, or of Professor J. E. Keeler, director of the Allegheny observatory.

— At Hanover, Penn., a system is used for cooling water, that is both simple and beneficial, according to a description of it in the *Railroad and Engineering Journal*. The town is described as being closely built, and without any system of drainage, so that the water in the wells is unfit to drink. Some years ago these reasons led to the introduction of a supply of very excellent water from a large spring about three miles distant. This water is brought through iron pipes, and when it reaches the consumer in summer is warm, while the water in the wells is cool. For this reason many of the inhabitants drink the well-water, and, as a consequence, typhoid-fver is a prevalent disease in that community. In order to obtain pure cool water, not impregnated with lime, some of the inhabitants of the place have adopted a plan which is so simple and gives such excellent results that it is worthy of general adoption wherever there is a water supply other than wells or springs. The plan is as follows. A cylindrical galvanized sheet-iron tank twelve inches in diameter and four or five feet long, is placed in the bottom of a well. The tank is then connected by a galvanized iron pipe with the water-supply pipes, and another pipe is carried from the tank to the surface of the ground, or to any convenient point for drawing water, and has a cock at the upper end. The tank is consequently always filled with water from the water-supply, and being in the bottom of the well, the water is cooled off and acquires the temperature of the well, so that that which is drawn from the tank is as cool as well-water, and is without any of the impurities with which the latter is contaminated. The water drawn from the tank in one of the wells in the place named had a temperature of 56° when the thermometer in the atmosphere above stood 76°. This method gives an abundant supply of cool water during the whole summer, and can be adopted in all cities, towns, or in the country. If a well is available, it can be used; if not, by simply digging a hole in the ground deep enough so as not to be affected by the surface temperature, and burying the tank, it will answer equally well. This hole might be dug in a cellar or outside the building. If the water has any impurities in suspension, such as mud, the tank should be made accessible, so that it can be cleaned separately.

— A writer in the *Illustrated American* says that in work which requires the application of great strength combined with good judgment the elephant is supreme; but as a mere puller and hauler he is not of great value. In piling logs, for example, the creature soon learns the exact manner of arranging them, and will place them upon each other with a regularity not to be excelled by a human workman. Sir Emerson Tennent, in his work on Ceylon, mentions a pair of elephants who used to raise their wood-piles to a great height by rolling the logs up an inclined plane of sloping beams. The same writer was once riding near Kandy, toward the scene of the massacre of Major Davies' party in 1803. He heard a queer sound in the jungle, like the repetition, in a hoarse and discontented tone, of the ejaculation of "Urmph, urmph!" Presently a tame elephant hove in sight, unaccompanied by any attendant. He was laboring painfully to carry a heavy beam of timber which he balanced across his tusks, but, the pathway being narrow, he had to keep his head bent in a very uncomfortable posture to permit the burden to pass endways, and the exertion and inconvenience combined led him to utter the dissatisfied noise which had frightened the horse. When the creature saw the horse and rider halt, he raised his head, reconnoitered them for a moment, and then he flung down the timber, thoroughly appreciating the situation, and pushed himself backward among the bushwood so as to leave a passage for the horse. But as the horse did not avail itself of the path, the elephant impatiently thrust himself deeper into the jungle, repeating his cry of "Urmph!" but in a voice meant to invite and encourage. Still the horse trembled, and the rider, anxious to observe the instinct of the two intelligent creatures, forbore any interference with them. Again the elephant wedged himself farther in among the trees and waited for the horse to pass, and after the horse had done so timidly and tremblingly, the wise creature stooped, took up his heavy burden, and, balancing it on his tusks, resumed his route, hoarsely snorting his discontented grunt as before.

— Experiments in seeding with different quantities of wheat were begun on the farm belonging to the Ohio State University several years previous to the establishment of the experiment station. These enperiments have been continued on the same farm by the station, and the tenth experiment has just been harvested. In this experiment two varieties of wheat were used, Dietz and velvet chaff (Penquite's velvet). The land on which they were sown had borne nine successive crops of wheat, having been dressed three times with barnyard manure during that period. The land occupied by the velvet wheat lies upon a gravel knoll, sloping to the west, the gravel coming in some places to within two or three feet of the surface. The wheat on this knoll has for several seasons been less vigorous than in other parts of the field, and this season especially it was badly infested with the wheat midge, commonly known as the red weevil. The Dietz wheat grew upon land of a little better quality, and sloping to the east instead of the west. It was but slightly injured by insects. While the yields of the velvet are irregular, they do not favor very thin seeding. In the case of the Dietz, however, the results are decisive. Every time the seed falls below four pecks or rises above seven there is a falling off in yield. In the long run, seeding at from five to seven pecks has given a larger harvest than when less or more seed was used.

— The idea of university extension had its first expression at Oxford as far back as 1845. Since then its advance has been constant and of late years very rapid. Though Oxford was the first university to give a form to the wide-spread desire for higher education, it was almost the last to enter upon the practical details of the work. That it now has by far the larger number of extension students is due in great measure to the energy and skill of Michael E. Sadler, secretary to the Oxford Delegacy, who, in the current number of *University Extension*, discusses the future of this movement in England. Other articles show the relation of this work to the common school teacher and to American women. One of the most successful experiments of last season in extension teaching was at Providence in connection with Brown University, and is described in this August issue by Professor Appleton of that faculty. In the department of Notes is an interesting hint as to the natural connection of this movement with the Chautauquan system, so excellently developed by Bishop Vincent and his assistants.