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- all nouss' experts should read. . CHE MISTRY AND METALLURGY.—Chemical Novelties. Grif-fith's paint. Manufacture of genatine. Tartaric acid. Zinc pigments. Aureosine colors. Rosaline acid colors. Preservation of wool. Frus-sian blue. Sulphuric acid. Memoving iron from clay.—Glycerine. By E. DONATH. Bpectral Analysis and the Identity of Chemical Elements. Experi-ments on the Halogen elements, and their apparent identity.
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THE TRANSMUTATION OF ELEMENTS.

posite nature of several, possibly all, of the substances strated by the researches of Prof. Crookes. hitherto accounted elementary, and the probability that all the elements so-called are but varying phases of some funda- with the radiometer, the molecules were set in motion by mental matter-stuff.

impurities in elements supposed to be perfectly pure.

But supposing these gentlemen to be wrong, and Mr. Lockyer right; supposing it true that all matter is fundamentally Prof. Crookes interprets as follows: The thickness of the one-would we be any nearer to the practical realization of dark space is the measure of the mean length of the path the alchemist's dream?

whichwe can have but the vaguest knowledge.

into the other would be scarcely greater than if they were borne by the finger. fundamentally distinct. The chemical behavior of the difnot mean that the prevailing theories and practices of chem. influence of gravitation. In Prof. Crookes' words: ists may not be materially changed-such changes are the

THE FOURTH STATE OF MATTER.

too slow to affect our eyes as light.

Indeed, while Pictet and others have been converting into in opposite directions. liquids and solids the most tenuous of gases, by successively novel set of properties.

at length in a paper unfortunately too long even to be sum-¹ assent to Prof. Crookes' assertion that the phenomena he

to exhibit the properties characteristic of the gaseous state, Not a little nonsense has been written with regard to Mr. and take on an entirely new set of properties. That this is a Lockyer's recent assertions concerning the probable com- matter of fact, and not of theoretic speculation, is demon-

In his previous studies of molecular activity in connection means of radiations producing heating effects. In the pres-It has been commonly assumed that if these assertions ent series of experiments the molecular motion was detershould be verified, the dreams of the alchemists would come mined or increased by the induced current from an induction true, and chemists would be able to change one form of coil. The investigation began by a study of the dark space matter into another, as lead into gold or silver. This as- which surrounds the negative pole when an induction spark sumption is altogether gratuitous. In his studies of the is passed through rarefied gas. The width of this dark space spectra of different substances under varying conditions of was found to vary with the degree of exhaustion of the tube; heat and pressure, Mr. Lockyer has indeed come to doubt with the kind of gas employed; with the temperature of the the integrity of the elements as commonly understood; and negative pole; and in a slight degree with the intensity of to believe that substances as unlike as calcium, lithium, the spark. For the study of these phenomena Prof. Crookes iron, and hydrogen, may be not only not fundamentally dis-devised a very ingenious instrument, which he calls an electinct, but that they may be merely different aspects of some trical radiometer, and a variety of other apparatus, of basic matter-stuff, of which hydrogen is the simplest form wonderful delicacy and power, by means of which he was at command. As yet, however, the evidence he has offered able to illuminate lines of molecular pressure; to converge is far from convincing; and able chemists who listened to streams of molecules upon a focus, with the evolution of his paper before the Royal Society, among them Professors light and heat and mechanical action; to deflect streams of Roscoe, Williamson, Frankland, and Gladstone, are of the molecules by means of magnets; to study the laws of magopinion that he has merely demonstrated the presence of netic deflection; to observe molecular shadows, so called, and other novel and extremely interesting phenomena.

The nature of the dark space around the negative pole between successive collisions of the molecules. The extra If matter be at bottom only hydrogen or some still simpler | velocity with which the molecules rebound from the excited substance, the existence of strongly marked phases of matter, pole keeps back the more slowly-moving molecules which like oxygen, iron, gold, and so on, can be explained only by are advancing toward the pole. The fight occurs at the supposing them to be the result of a process of natural se-boundary of the dark space, where the luminous margin lection operating through past ages, under conditions about bears witness to the energy of the collisions of the molecules. When the exhaustion is sufficiently high for the We know that life in all its phases is fundamentally the mean length of the path between successive collisions to be same, yet those phases are in the main, so far as we are con-greater than the distance between the electrode and the glass, cerned, unchangeable, certainly not transmutable. Even if the swiftly-rebounding molecules spend their force, in part or the common origin of the horse and the zebrashould be dem- in whole, on the sides of the vessel, and the production of onstrated beyond the possibility of a doubt, we should be no light is the consequence of this sudden arrest of velocity. better able to transmute zebras into horses than we are now. When streams of molecular discharge are focused upon a So if it be demonstrably true that two phases of one mat-strip of platinum wire or foil, the metal becomes not only ter-stuff, like silver and lead, have resulted from the cosmical luminous but highly heated by the severity of the bombardprocesses of material evolution, acting through the cycles of ment; so, too, the molecular impact upon the side of the inthe past, the probability of our being able to change the one closing glass may be sufficient to make the spot too hot to be

The limits of our space forbid any attempt to describe at ferent sorts of matter is quite independent of any theoretical length the phenomena of magnetic deflection or the ingenotions with regard to the ultimate constitution of such sub- nious apparatus by means of which the action of the magnet stances; and chemistry will remain substantially what it is, upon the trajectory of molecules was made visible. Under whatever may be the outcome of the investigations of Mr. the influence of a magnet the behavior of a stream of mole-Lockyer and those engaged in similar work. By this we do cules is likened to that of a stream of cannon balls under the

"Comparing the free molecules to cannon balls, the magnecessary result of increasing knowledge-but simply that netic pull to the earth's gravitation, and the electrical excithe popular talk about the radical overturning of the science, tation of the negative pole to the explosion of the powder in as the result of Mr. Lockyer's alleged discoveries, is sheer the gun, the trajectory will be flat when no gravitation acts, nonsense, even if his utmost expectation should be realized. and curved when under the influence of gravitation. It is, also, much curved when the balls pass through a dense resisting medium; it is less curved when the resisting medium That the three states of matter, the solid, the liquid, and gets rarer; and, as already shown, intensifying the induction the gaseous, though widely different in their properties, are spark, equivalent to increasing the charge of powder, gives yet only so many stages in an unbroken chain of physical greater initial velocity, and, therefore, flattens the trajectory. continuity, has been amply demonstrated. The solid passes The parallelism is still closer when we compare the evoluinto the liquid, the liquid into the gaseous form of matter, tion of light seen when the shot strikes the target with the by insensible gradations; and there is nothing any more phosphorescence on the glass screen from molecular imimprobable in the supposition that these three states do not pacts." Applied to a stream of molecules the magnet exhaust the possibilities of material condition, than in sup-twists the trajectory of the molecules round in a direction posing the possibilities of sound to extend to aerial un at an angle to their free path, and to a greater extent as they dulations to which our organs of hearing are insensible, or are nearer the magnet, the direction of the twist being that the possibilities of vision to ethereal undulations too rapid or of the electric current passing round the electro-magnet. The two poles of the magnet, we may add, twist the stream

Prof. Crookes, very improperly, we think, speaks of the shortening the range of their molecular movements, Prof. stream of molecules thus brought under observation as rays Crookes has, on the other hand, succeeded in refining gases of molecular light. True, light is evolved by their impact to a condition so ethereal as to reach a state of matter fairly under suitable conditions; so it may be by the impact of a describable as ultra-gaseous, and exhibiting an entirely stream of cannon balls. The impact of the flying molecules raises the temperature of any body interposed to arrest their The means by which this remarkable result was achieved flight, just as the impact of a stream of cold cannon balls were exhibited and described by Prof. Crookes at a meeting would heat a resisting body arresting their flight; but we of the British Royal Society early last December; and the cannot call the one stream a ray of light or heat any more processes by which the discovery was made were discussed properly than the other. With this reservation, we may

O. D. MUNN.

uses of the tuning fork as a chrönometer to mark minute intervals of time. The velocity or totation of a wheel measured by a tuning fork. The laws of falling bodies written on a falling plate by a tuning fork. The velocities of cannen balls measured by the tuning fork. The speed with which the nervons motion and sensitive agent travels along the nerves, measured by the tuning fork. With 5 figures. VI. ELECTRICITY. LIGHT. HEAT, ETC.—Plateau's Films. Experi-ments upon liquids which have been freed from the influence of grav-ity. Laws governing the formation of liquid films, with recipe for making permanent films. 15 figures. How to make an Induction Coll. By GEO. M. HOFKINS. A most useful, valuable, and practical paper, containing full instructions to enable any intelligent person to construct and use induction colls that : will yield a spark 1% inch long, decompose water, charge a Leyden bat-terv, light gas, exhibit the phenomena of electric light in vacuo, etc., and may be used in numerous interesting experiments to be given in a succeeding issue. A cheap, simple, and effective form of coll. The number of wire for the primary and the secondary colls. How to make the spool, and how to wind it. How to insulate between the layers. The pool, and how to wind it. How to insulte between the layers. Construction of the base box, and arrangement of the condenser. The commutator, with all its parts ilustrated and described. All parts plainly shown in three working drawings to scale. Diagram and explasion of connections and mode of operation. All particulars of construction, with amount of wire required for each coll, dimensions of all parts and kind of battery to use. Collin's City Time Regulator. 2 engravings. Stroumbo's Apparatus for Determining the 'Asgnetic Incilination and Declination. If gure. A Breath Battery and Telephone. 4 figures.
VII. MEDICINE AND HYGIENE. The Remains of William Harvey, the indiscoverer of the circulation of the blood. An interesting account of the death of Harvey as it now exists. With 'lillustration, and a portrait. View of the interior of the Harvey valut, showing the sarcophangue of Harvey as it now exists.
Mik as a Vehicle of Contagion. By ALETANDER R. BECKER, M.D. The germ theory of disease. The present milk isws and milk inspectors. A probable cause of some city epidemics.—Laughter as a Medicine. I

marized here. It may be possible, however, to give an idea has investigated in his exhausted tubes reveal to physical of their character and drift without the aid either of graphic science a new field for exploration, a new world-" a world illustrations or abstrusely scientific terms. wherein matter exists in a fourth state, where the corpuscu-

lar theory of light holds good, and where light does not Our readers need not be told that the physical properties of gases are due to their molecular condition; in other words, always move in a straight line, but where we can never to the swing and impact of their molecules, and the average enter, and in which we must be content to observe and expelength of flight of the molecules between collisions. As the riment from without."

number of molecules in a given space is reduced by mechanical exhaustion, the frequency of molecules collision is of necessity reduced, and the mean molecular flight is corre-

spondingly extended. Now it is obvious that if the tenuity

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REFINING SUGAR.

of the gas is very greatly increased, as in the most perfect One of the best thermometers of a nation's prosperity is the vacua attainable, the number of molecules may be so sugar it consumes. In epochs of great financial depression diminished that their collisions under favorable conditions and commercial stagnation the consumption is small as commay become so few, in comparison with the number of pared with periods of general prosperity. Indeed the promisses, that they will cease to have a determining effect, portionate consumption of sugar is so accurately distributed upon the physical character of the matter under observation. with respect to national prosperity or depression that it In other words, the free flying molecules, if left to obey the really constitutes a true gauge of both. It is also a good test laws of kinetic force without mutual interference, will cease of civilization and cultured taste—the more civilized