thus stimulated by dumping into the neck of the funnel large pieces of turf. In the Yellowstone district, it has been found that a small amount of soap or lye added to the geyser water will frequently hasten eruption. This is explained by Hague ("Soaping Geysers," *Trans. Amer. Inst. Min. Eng.*, vol. xvii., 1889, p. 546) as due to the increased viscosity of the liquid. "Viscosity must tend to the retention of steam within the basin and . . . explosive liberation must follow . . . Viscosity in these hot springs must also tend to the formation of bubbles and foam when the steam rises to the surface, and this in turn aids to bring about the explosive action, followed by a relief of pressure, and thus to hasten the final and more powerful display." Graham (*American Journal of Science*, January 1893, p. 54), as a result of experiments with an artificial geyser, agrees that viscosity has much to do with the confinement of steam, but questions the influence of bubbles and foam.

Experiment 3.—*The Effect of Soap.*

The apparatus was arranged to give regular eruptions as in Experiment 1, with the geyser-tube flush with the bottom of the basin and the water maintained about an inch deep in the basin without overflow. A small quantity of fine shavings of Ivory soap was thrown into the basin: these gradually dissolved and the milky solution was, after several eruptions, sucked into the flask below. The occasional steam-bubbles, which, in pure water, rise rapidly through the geyser-tube and escape at the surface during the intervals between eruptions, were less numerous, very small, and slower in their upward movement through the soapy solution; after five or six eruptions it became evident that the intervals were somewhat shorter (averaging 1 min. 20–30 seconds, instead of 1 min. 30–40 seconds), and the periods very noticeably longer (40–45 seconds, instead of 20 seconds). The ebullition in the flask was more violent than in the case of pure water, and columns of fine bubbles accumulated in the geyser-tube, only to be ejected with a violent sputter and give place to a new accumulation. It was evident that these accumulated myriads of tiny steam bubbles, confined within the tube and adhering to the walls of the tube, formed a cushion opposing considerable resistance to pressure from below.

After the diffusion of the soapy solution had become general, the reservoir (and consequently the geyser-column) was lowered to the level *a*; the intervals were at once shortened to an average of about one minute, in consequence of the rapid accumulation at the surface of the column and *within the tube* of the cushion of steam bubbles. So resistant is this cushion, that as it grows by the addition of new bubbles rising from below, the water column is actually depressed, down to the neck of the flask; here a point is reached where the frictional resistance of the froth cushion and the hydrostatic pressure are balanced. A further accumulation of steam forces up the column of foam, release of pressure permits the water to burst into violent ebullition, and an eruption takes place. From this it would appear that in those geysers where the tube is small, the growth of a cushion of steam soap-bubbles may play a very important part in accelerating the development of eruptive conditions.

Summary.

(1) Geysers and boiling springs are subject to the laws of hydrostatic pressure, in common with other springs.

(2) In a geyser-spring, overflow once established may be maintained by convection even against a reversed head; this leads to a critical point in the spring's mode of discharge.

(3) In this condition, with a constant source of heat, very slight changes in the local head are sufficient to induce a change in the nature of a geyser-spring's mode of action. Such change in the head may be caused by variation in rainfall, by building up a sinter cone by forcing new outlets at lower levels, or by clogging of old conduits.

(4) Geyser basins afford drainage channels for meteoric waters. The drainage takes place by either continuous overflow (hot springs) or spasmodic eruption (geysers). Both types, as well as transitional forms, are represented in the Yellowstone Park.

(5) In general, those geysers which are irregular in their eruptions have continuously overflowing vents; and the most regular geysers have confined waters, which overflow only during eruption. This is explained by the fact that the overflowing vents are under hydrostatic pressure, cooler water from lateral ducts is continually replacing that which flows off, and the ebullition necessary to produce eruption is thus prevented; eruption can only take place in the seasons of minimal inflow of cooler water, when the heat is in excess. Where the water is confined, on the other hand, and the supply of heat constant, cooler water rushes in only after each eruption, and a definite interval is required to bring it to the boiling point at the base of the column. Overflowing and confined springs should be distinguished in any description or classification of geysers.

(6) For the artificial stimulus of geyser eruption, an important effect of the bubble forming alkalies, in small tubes, is the initial depression of the water-column by the growth of a confined cushion of minute steam bubbles. The release of pressure induced by the final ejection of the froth column causes eruption.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DR. MERRILL E. GATES has resigned the presidency of Amherst College.

THE following appointments are announced:—Dr. Charles Harrington to be assistant professor of hygiene, and Dr. Franz Pfaff to be instructor in pharmacology and physiological chemistry in Harvard University; Mr. R. A. Emerson to be assistant professor of horticulture at the University of Nebraska.

Science announces the following gifts for educational and scientific purposes:—50,000 dollars, from a source kept secret, to Amherst College, for an academic hall in honour of President Seelye; 20,000 dollars from Mr. H. L. Higginson, treasurer of the J. W. and Belinda Randall Charities Corporation of Monson, Mass., for the erection of a building, or as a permanent fund in connection with the University of Virginia. *Science* also states that two conditional gifts of 50,000 dollars, offered by Dr. D. K. Pearsons, have been secured by the colleges collecting the additional sums required. The endowment of Beloit College is thus increased by 200,000 dollars, and that of Mt. Holyoke College by 150,000 dollars.

THE *Calcutta Gazette* reports that representatives of La Martinière and Doveton Colleges have been appointed to consider the advisability or otherwise of the amalgamation of the two institutions. It appears that for many years these two colleges carried on with efficiency, and at a standard which compared favourably with corresponding schools in England, a large portion of the work of secondary education in Calcutta; but in recent years both La Martinière and Doveton, from causes over which they have had little control, have fallen behind in the race for up-to-date education. Owing to the keen competition of newly-opened hill schools, and the consequent loss of scholars and fees, also owing to heavy reduction in interest on the capital invested in Government securities, these colleges have not been able to keep pace with the requirements of modern education; while, on the other hand, they have been handicapped by heavy expenditure on the up-keep of extensive buildings and the payment of large sums in municipal rates and taxes. To remedy this state of affairs, which every year becomes more serious and pressing, the amalgamation of the two institutions has been suggested, in the hope that the result would be a considerable decrease in expenditure and a consequent gain in discipline and efficiency. It is fully recognised that there are difficulties in the way of the realisation of this scheme, but the Lieutenant-Governor sees no reason to believe them insurmountable. The aims and objects of the two institutions are almost identical, and it is hoped that petty differences of detail may not be allowed to stand in the way of arriving at a common understanding as to some broad scheme of amalgamation on lines which, by uniting the resources of the two colleges, will enable them to provide that standard of European education which it was the intention of their founders to give, but which under existing conditions it is practically impossible that either college alone can supply from its unaided resources.

SCIENTIFIC SERIALS.

THE *Mathematical Gazette*, issued under the auspices of the Mathematical Association, continues to maintain its interesting collection of notes and solutions to problems. The June number, recently issued, contains, in addition to these notes, papers by Mr. H. B. Billups on the connection between the inscribed and escribed circles of a triangle, and by Mr. R. F. Muirhead on relative motion. We should be glad to see more articles in the *Gazette* dealing with questions of general principle, rather than

with neat solutions of special problems; such subjects as the methods of teaching "Progressions" in Algebra might well afford interesting material for discussion.

THERE are several interesting papers in the *Journal of Botany* for June and July 1898.—A figure is given of the newest addition to our phanerogamic flora, *Stachys alpina*.—Mr. H. N. Dixon adds also a new moss (from Perthshire) to the British flora, *Plagiothecium Müllerianum*.—The "Recent Literature on Algæ," by Miss Ethel S. Barton, contributed from month to month, is a useful feature.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, July 4.—M. Wolf in the chair.—The Perpetual Secretary announced to the Academy the death of M. Ferdinand Cohn, Correspondant in the Botanical Section.—M. Van Tieghem added a short appreciation of the work of the late Prof. Cohn.—Numerical tables for facilitating the development by interpolation of the disturbance function, by M. O. Callandreau.—On the elastic equilibrium of a dam of masonry of triangular section, by M. Maurice Lévy.—On the maintenance of the motion of a pendulum without disturbance, by M. G. Lippmann. A series of instantaneous impulses is given to the pendulum, equal, but of contrary signs, the algebraic sum of the disturbance being equal to nothing. If the impulses are imparted as the pendulum swings through its position of equilibrium, each separate disturbance also becomes vanishingly small.—New observations on the Zeeman phenomenon, by MM. Henri Becquerel and H. Deslandres. In a very intense magnetic field (35,000 C.G.S. units) the bands of nitrogen and cyanogen (the "carbon spectrum") show no signs of doubling nor enlargement, although the rays of the air spectrum were, under the same conditions, strongly divided. Most of the rays examined undergo the division into triplets announced by M. Zeeman; certain rays, however ($\lambda = 3788{\cdot}01$, $\lambda = 3743{\cdot}45$ in the iron spectrum), split up into five. The distribution of these split-up rays, considered as a function of the wave-length, shows signs of periodicity.—On the decomposition of water by chromous salts, and on the use of these salts for the absorption of oxygen, by M. Berthelot. Solutions of pure chromous chloride, free from all trace of free acid, give no trace of hydrogen gas, even after eleven years. In presence of a trace of hydrochloric acid, a minute quantity of hydrogen is evolved, which becomes very appreciable at 250° C. Hence acid solutions of chromous chloride cannot be used for the removal of oxygen in exact work, except in the case of hydrogen.—On the reaction between hydrogen gas and nitric acid, by M. Berthelot. Hydrogen is not absorbed by pure nitric acid, either in the cold or at 100°, even after twenty hours contact.—Preparation and properties of calcium hydride, by M. Henri Moissan (see p. 257).—On apple orchards on pasture land, by M. Ad. Chatin.—Notice on the life and work of M. Paul Serret, by M. Darboux.—Velocity of propagation of discontinuities in media at rest, by M. Paul Vieille.—The relation of metallic envelopes to the Hertzian oscillations, by M. Edouard Branly. The Hertzian oscillations are completely arrested, even by a very thin metallic envelope, if the latter is hermetically closed.—Mechanism of the discharge by the X-rays, by M. G. Sagnac.—Irreversible isothermal transformations of a mixture. Development of the conditional relation of equilibrium, by M. A. Ponsot.—On blue glass with chromium base, by M. André Duboin. Account of some experiments on the production of blue glass. The three glasses, $4{\cdot}5SiO_2.Al_2O_3.3BaO$, $4{\cdot}5SiO_2.Al_2O_3.1{\cdot}5CaO, 1{\cdot}5BaO$, and $28SiO_2.9B_2O_3.16BaO.3Al_2O_3$, coloured either with potassium bichromate or chromic oxide, give very fine blue glasses.—On copper selenate and its use in the preparation of selenic acid, by M. R. Metzner. Selenium is converted into selenious acid, and this oxidised in solution with chlorine. Copper oxide is added to this liquid, and evaporation gives fine prisms of copper selenate. Pure selenic acid is obtained from this by electrolysis.—Action of hydrogen upon potassium paratungstate, by M. L. A. Hallopeau. At a low temperature a mixture of the blue oxide with the dioxide of tungsten is obtained. At a higher temperature tungsten bronze ($K_2O.WO_3 + WO_2.WO_3$) is formed.—Volumetric analysis in alkaline solution by a ferrous reducing agent, by M. André Job. The reducing liquid is made by adding an acid solution of ferrous ammonium sulphate to an excess of sodium pyrophosphate. The excess of the iron salt can be exactly determined by standard iron solution. The solution in sodium pyrophosphate is colourless and remains so during the oxidation, and is as energetic in its reducing power as stannous chloride.—Volumetric analysis of a mixture of acid ethyl phosphates and phosphoric acid, by M. J. Cavalier.—On the estimation of phosphoric acid, by M. Henri Lasne. A discussion of the results given by M. Leo Vignon.—On the phenylurethanes of the ethers and nitriles of some oxy-acids, by M. E. Lambling. The urethanes described were the phenylurethanes of ethyl lactate, trichlorolactate, of trichlorolactic nitrile, glycollic ether and nitrile, phenyl glycollic ether and nitrile, and α- and β-ethyl oxybutrates.—On a new combination of acetylene with cuprous oxychloride, by M. R. Chavastelon. By the action of water upon the compound $Cu_2Cl_2.C_2H_2$, previously described, the substance $Cu_2O.Cu_2Cl_2.C_2H_2$ is obtained.—On ethane-pyrocatechol, by M. Ch. Moureu.—On the elimination of chlorides in rickets, by M. Œchsner de Coninck.—Absorption of liquids by textiles, by M. Leo Vignon. Textiles have a specific absorbing power for each liquid, the order of magnitude of this constant being silk, wool, and cotton.—The hematozoa of goitre, by M. E. Grosset. The parallelism between goitre and malaria is shown to be very well marked, and drawings are given of parasitic organisms, hematozoa, always present in the blood of recent cases of goitre.—On the functions of the pancreas in the Squalidæ, by M. Émile Yung.—On the development and structure of the larva of some cheilostomatous bryozoa, by M. Louis Calvet.

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