researches relating to invertebrates, cryptogams, &c., is continued as usual.

THE *Revue des Sciences Naturelles*, June 15, contains: M. Hesse, description of two new crustacea, male and female, of the genus Dinemoura (*D. mustela lævis*) (Plate 1). The figures are coloured from living specimens; the species lives not in the interior of the shark, but on its skin, and its mode of fixation is minutely described.—M. Duval-Jouve, on the species of Vulpia to be found in France.—D. A. Godron, on the giant maize (*Zea caragua*).—M. Rietsch, on Bobretzki's studies on the formation of the blastoderm and germinal lamellæ in insects.—A. Villot, the synchronism of the marls and clays with lignite of Hauterives with the group of St. Ariès.—M. S. Jourdain, on a very simple form of the group of worms *Prothelminthus hessi* (S. J.) = ? *Inthosia leptolanæ*, Giard (Plate 2).—Scientific review of recent French writings on zoology, botany, and geology.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, June 17.—"On the Spectrum of the Flame of Hydrogen," by William Huggins, D.C.L., F.R.S.

Messrs. Liveing and Dewar state, in a paper read before the Royal Society on June 10, that they have obtained a photograph of the ultra-violet part of the spectrum of coal gas burning in oxygen, and in a note dated June 8 they add that they have reason to believe that this remarkable spectrum is not due to any carbon compound but to water.

Under these circumstances I think that it is desirable that I should give an account of some experiments which I made on this subject some months since without waiting until the investigation is more complete.

On December 27, 1879, I took a photograph of the flame of hydrogen burning in air. As is well known, the flame of hydrogen possesses but little luminosity, and shows no lines or bands in the visible part of the spectrum, except that due to sodium as an impurity.

Prof. Stokes, in his paper "On the Change of Refrangibility of Light,"[1] had stated that "the flame of hydrogen produces a very strong effect. The invisible rays in which it so much abounds, taken as a whole, appear to be even more refrangible than those which come from the flame of a spirit lamp." I was not, however, prepared for the strong group of lines in the ultraviolet which, after an exposure of one minute and a half, came out upon the plate.

Two or three weeks later, about the middle of January, 1880, I showed this spectrum to Prof. Stokes, and we considered it probable that this remarkable group was the spectrum of water. Prof. Stokes permits me to mention that, in a letter addressed to me on January 30, he speaks of "this novel and interesting result," and makes some suggestions as to the disputed question of the carbon spectrum.

I have since that date taken a large number of photographs of the spectra of different flames, in the hope of being able to present the results to the Royal Society, when the research was more complete. I think now that it is desirable that I should describe the spectrum of the flame of hydrogen, but I shall reserve for the present the experiments which relate to the presence of carbon and its compounds.

The spectrum of the flame of hydrogen burning in air is represented in the diagram. It consists of a group of lines which terminates at the more refrangible limit in a pair of strong lines, λ 3062 and λ 3068. At a short distance in the less refrangible direction, what may be regarded as the group proper commences with a strong line, λ 3090. Between the strong line λ 3068 and the line λ 3090 there is a line less bright, λ 3080. Less refrangible than the line λ 3090 are finer lines at about equal distances. The lines are then fine and near each other, and appear to be arranged in very close pairs. There is a pair of fine, but very distinct lines, λ 3171 and λ 3167. In this photograph the group can be traced to about λ 3290. This group constitutes the whole spectrum, which is due probably to the vapour of water.

I then introduced oxygen into the flame, leaving a small excess of hydrogen. A spectrum in all respects similar came out upon the plate. I repeated the experiment, taking both spectra on the same plate. Through one-half of the slit the spectrum of the oxyhydrogen flame was taken. This flame was about 7 inches long, and the spectrum taken of a part of the flame 2 inches from the jet. The oxygen was then turned off, and the quantity of hydrogen allowed to remain unaltered. A second spectrum with an exposure of the same duration was then taken through the second half of the slit. On the plate the two spectra are in every respect similar, and have so exactly the same intensity that they appear as one broad spectrum.

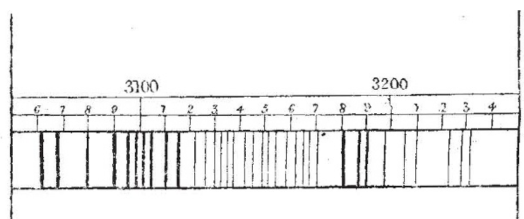
In all these experiments a platinum jet which had been carefully cleaned was used.

In these experiments the two gases met within the blowpipe and issued in a mixed state.

The jet was removed, and a flame of hydrogen was surrounded with oxygen. This spectrum shows some additional lines. In this case the jet was brass, and in this or some other way impurities may have been introduced; and I should at present incline to the view that the additional lines about λ 3429 and λ 3473, and the groups more refrangible than λ 3062, do not belong to the water spectrum, but to impurities.

Coal-gas was substituted for hydrogen in the oxyhydrogen blowpipe, and oxygen admitted in as large a proportion as possible. The inner blue flame rising about 2 inches above the jet showed in the visible part of the spectrum the usual "five-fingered spectrum." The light from this part of the flame was projected upon the slit. The spectrum contains the water group already described, and in addition a very strong line close to G, and two lines, λ 3872 and λ 3890; this latter line is seen to be the more refrangible limit of a group of fine lines shading off towards K.

The ultra-violet group, when carefully compared with the group in the spectrum of pure hydrogen, shows several small differences. I am inclined to believe that there is the supposition of a second fainter group. There is strong evidence of this in some spectra of hydrogen taken under other conditions. There is also a broad band less refrangible than the strong line at G, and the light extends from this line on its more refrangible side.



Spectrum of Water

A double Bunsen burner (Fletcher's form) with a strong blast of air was then fitted up. The spectrum was taken of the intense blue flame. It resembles the one last described. All the distinctive features are intensified, and a continuous spectrum and groupings of very fine lines fill up all the intervals between the groups already described, so that there is an unbroken strong spectrum throughout the whole region which falls upon the plate.

A spirit lamp was arranged before the slit. The spectrum is essentially the same as when coal-gas is burned, but as it is less intense only the strongest lines are seen. The water group, the strong line at G, and the pair of lines rather more refrangible than K, are seen. Probably with a longer exposure the finer lines would also show themselves.

The distinctive features of the spectra of coal-gas and of alcohol appear to be connected with the presence of carbon.

Table of Wave-lengths of the Principal Lines of the Spectrum of Water. No. 1.

3062	3095	3135	3171	3217·5
3068	3099	3139	3175	3223
3073	3102	3142·5	3180	3228
3074	3105	3145	3184	3232
3077·5	3111	3149·5	3189	3242·5
3080	3117	3152·5	3192·5	3252·5
3082	3122·5	3156	3198	3256
3085	3127	3159·5	3201	3262
3090	3130	3163	3207·5	3266
3094	3133	3167	3211	3276

[1] *Phil. Trans.*, 1852, p. 539.

Wave-lengths of other Lines in the Spectra described above.

2869·5	2910	2947	2991	3031
2872·5	2913	2951	2994	3039
2876	2917·5	2955	2999	3042
2880	2922·5	2959	3002	3046
2883	2925·5	2966	3005	3051
2887·5	2929	2967·5	3010	3057·5
2892	2932·5	2970·5	3013	3246
2895	2935·5	2975·5	3017	3271
2897	2940	2981	3019·5	3429·5
2904	2943	2989	3029	3473
2907·5				
3872		3890		4310

Edinburgh

Royal Society, June 7.—Prof. Fleeming Jenkin, vice-president, in the chair.—The Council having awarded the Keith prize for the biennial period 1877-79 to Prof. Fleeming Jenkin for his paper on the application of graphic methods to the determination of the efficiency of machinery, the medal was presented to him by Prof. Balfour.—At the request of the Council Prof. Chrystal gave an address on non-Euclidian geometry, and discussed in a most masterly and lucid manner the consequences which the non-acceptance of Euclid's axiom of parallels involved. Defining a straight line as the curve completely determined by two points, the lecturer pointed out that there were three simple cases that called for discussion: first, the case where two straight lines cut in one point only and are infinite in extent; second, the case where two lines still cut in but one point, but each line is finite in length returning into itself; and third, the case where two straight lines cut in two points. Some of the peculiar properties of these three kinds of space, which might be called hyperbolic, single elliptic, and double elliptic space, were demonstrated, and many others pointed out, while Euclidian or homoloidal space was shown to be a limiting case of either hyperbolic or elliptic space.—Prof. Tait communicated a note on the theory of the 15 puzzle, in which he gave a rule for determining whether or no a particular arrangement could be solved.—Mr. de Burgh Birch, M.B., C.M., read a detailed paper on the constitution of adult bone matrix and the functions of osteoblasts.—Mr. Robert Gray exhibited two eggs of the Great Auk (*Alca impennis*), and read a short graphic account of the extinction of that bird within the present century.—Prof. Chrystal exhibited a new form of telephone receiver which was simply a fine wire, whose extension and contraction under the influence of the heating and cooling caused by the varying intensity of the current through the microphone transmitter were sufficient to communicate musical notes to a vibrating membrane. Mr. Blyth's recent communication to the Society, together with certain observations of his own on the rapid cooling and heating of thin wires which he had made several years before, had suggested the arrangement as one likely to succeed.

Paris

Academy of Sciences, July 12.—M. Edm. Becquerel in the chair.—The following papers were read:—Observations of the comet *b* 1880 (Schäberle) made at Paris Observatory, by MM. Tisserand and Bigourdan.—On the pendulum, by M. Faye. He announces a new apparatus with which M. Govi's system (see below) and others may be studied. The reductions are limited almost exclusively to temperature.—Observations on the density of iodine vapour, by M. Berthelot. The increase of total energy of the halogen gases with the temperature, as also that of the *vis viva* of translation, exceed those of the three other simple gases hitherto studied (nitrogen, oxygen, and hydrogen); the two orders of effects seem correlative.—On the heat of formation of hydrocyanic acid, and of cyanides, by M. Berthelot.—Densities of vapour of selenium and tellurium, by MM. Sainte-Claire Deville and Troost. This gives details of operations in 1863.—On the etiology of anthrax, by M. Pasteur. Putrefaction of the animal's body destroys the parasite, but some infected blood and other liquid matter escapes into the ground about the body, and there germs may be produced and remain with latent life for years, ready to communicate anthrax on opportunity. Curiously, the bacteridium-germs may be found in the surface-earth over the body, and they appear to come thither by agency of earth-worms, carrying them in their alimentary canal. The dust of this earth, with the worms' excrement, gets blown about the plants, which the cattle eat, and are thus infected. Germss of other diseases may perhaps be conveyed similarly.—Ammonia of the air and of water, by M. Lévy. *Inter alia*, contrary to what is observed in meteoric waters, it is in the hot season that ammoniacal nitrogen seems to be most abundant in the air. The annual averages in the case of meteoric waters are nearly identical.—Alternance of generations in some Uredineæ, by M. Cornu.—New theorems on the indeterminate equation $ax^4 + by^4 = z^2$, by M. Pepin.—On some remarks relative to the equation of Lamé.—New method for determining the length of the simple pendulum, by M. Govi. A pretty long, light, and rigid rod is suspended by one end from a horizontal axis, and a heavy runner, with centre of gravity in the axis of the rod, in fixed at different points, and the pendulum set oscillating is vacuo on solid supports.—Rapid synthetic method of establishing the fundamental formulæ relative to change of state, by M. Viry.—On the constitution of matter and the ultra-gaseous state, by Mr. Crookes.—On monochromatic lamps, by M. Laurent. *Apropos* of M. Terquem's note, he recalls his modifications of gas-burners and his æolipyle.—Telephonic effects resulting from the shock of magnetic bodies, by M. Ader. Any mechanical action which disturbs the state of molecular equilibrium of a magnetic core has the effect of developing, when this core suddenly regains its equilibrium, an electric current capable of affecting the telephone.—On the fluorised compounds of uranium, by M. Ditte.—On the atomic weight and on some characteristic salts of scandium, by M. Nilson. Atomic weight, 44.—Ultimate action of bromine on malonic acid; bromoform, by M. Bourgoin.—On the etherification of sulphuric acid, by M. Villiers.—On the reproduction of *Pleurodeles waltlii*, by M. Vaillant.—Salivary glands in the Odonates (Neuroptera), by M. Poletaieu. These glands exist in all the species (though they are denied by entomologists).—Action of high and moist temperatures and of some chemical substances (benzoate of soda, benzoic acid, sulphurous acid) on germination, by M. Heckel. Seeds of *Brassica nigra* sown in a wet sponge and kept at 48° showed numerous radicles in less than twelve hours (while seeds kept in water at 48° never germinated). After emitting their radicles the seeds stopped, but they developed quickly when the temperature was brought down to 20° or 17°·5. The three chemical agents suspended the germination of various seeds.—Action of strychnine in very strong dose on mammalia, by M. Richet. It acts somewhat like curare and somewhat like chloral.—Alterations of the nerve-tubes of the anterior and posterior nerve-roots and of the cutaneous nerves in a case of generalised congenital ichthyosis, by M. Leloir.—On immunity against anthrax, acquired through preventive inoculations, by M. Toussaint.

CONTENTS