

may not the general conclusion be drawn, that the strength of vitality of the impregnated ovum, or its power of resisting agencies unfavourable to its life, gradually increases with age and the progress of foetal development? And as the Charr is one of the most delicate of the family of fishes to which it belongs, may it not further be inferred, with tolerable confidence, that the ova of the other and more hardy species of the Salmonidæ, were they similarly experimented upon, would afford like results, confirmatory of those obtained last year in some trials on the ova of the Salmon, and mentioned in my former letter to you?

The practical application of these results, and of the conclusions deducible from them, is obvious, and need not at present be dwelt upon.

I am, my dear Sir,

Yours very truly,

JOHN DAVY.

Lesketh How, Ambleside,
January 10, 1856.

II. "Note on a new Class of Alcohols." By M. AUG. CAHOURS and A. W. HOFMANN, Ph.D., F.R.S. &c. Communicated by Dr. HOFMANN. Received January 31, 1856.

On submitting to dry distillation glycerine, either alone or together with bisulphate of potassium or anhydrous phosphoric acid, M. Redtenbacher obtained a remarkable product, to which he gave the name of acroleine. Presenting all the characters of an aldehyde, and approximating more particularly to vinic aldehyde by the general aspect of its reactions, this substance changes under the influence of oxidizing bodies, especially of oxide of silver, an acid being formed, named by this philosopher acrylic acid, an acid which stands in the same relation to acroleine as acetic acid does to aldehyde.

The researches of MM. Will and Wertheim on the essential oils of mustard and of garlic, tended to indicate a relation between these substances on the one hand and acroleine and acrylic acid on the other, a result which was established by the more recent investiga-

tions of MM. Berthelot and De Luca. On studying the action of iodide of phosphorus on glycerine, these chemists obtained an iodine-compound named by them iodide of propylene, which is an analogue of the chloride and bromide of propylene, previously produced by MM. Cahours, Reynolds, and Hofmann, when submitting to the action of chlorine and bromine the gases which are formed when either amylic alcohol or valeric acid and its homologues are exposed to the influence of heat.

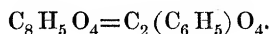
MM. Berthelot and De Luca have further shown that the result of the mutual decomposition of iodide of propylene and sulphocyanide of potassium is an oil identical with that obtained on distilling the seeds of black mustard with water in an alembic. By this remarkable experiment it is most clearly demonstrated that the volatile oil of mustard belongs to the propylene series, a relation which had been previously pointed out by Capt. Reynolds, but which he has omitted to establish by experiment. If, then, we admit the existence of a hydrocarbon, C_6H_5 , analogous to ethyl, C_4H_5 , we get

C_6H_5Cl	Chloride of propylene.	C_4H_5Cl	Chloride of ethyl.
C_6H_5Br	Bromide of propylene.	C_4H_5Br	Bromide of ethyl.
C_6H_5I	Iodide of propylene.	C_4H_5I	Iodide of ethyl.
C_6H_5S	Essential oil of garlic.	C_4H_5S	Sulphide of ethyl.
$C_6H_5C_2NS_2$	Essential oil of mustard.	$C_4H_5C_2NS_2$	Sulphocyanide of ethyl.
$C_6H_4O_2$	Acroleine	$C_4H_4O_2$	Aldehyde.
$C_6H_4O_4$	Acrylic acid.	$C_4H_4O_4$	Acetic acid.

All that now remained was to discover the keystone of this edifice, in other words, to establish the existence of an alcohol to which the preceding compounds might be referred, and by the aid of which a still more numerous series of ethers, both simple and compound, and analogous in every respect to the derivatives of ordinary alcohol, might be obtained. After many protracted and unsuccessful attempts, we have succeeded in producing the alcohol and ether of this series, for which we propose retaining the name of the acryl series.

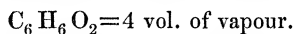
In order to arrive at this result, we have submitted several silver-salts to the action of iodide of acryl. There are but few acids whose salts lend themselves conveniently to this reaction. Among the various salts which we have examined with this view, the oxalate of silver has furnished the most satisfactory results. This salt is most violently attacked by iodide of acryl; the reaction is complete after

two or three hours' digestion. The *oxalate of acryl* formed in this process, when separated from the iodide of silver, washed with water, dried over chloride of calcium, and redistilled, presents itself as a colourless transparent liquid, heavier than water, possessing a peculiar aromatic odour. It boils at 207° , and by analysis has been proved to contain



When treated with ammonia, oxalate of acryl furnishes oxamide and the alcohol, which was the object of our researches. This alcohol—*acrylic alcohol*—is a colourless transparent liquid of a peculiar, somewhat pungent odour, resembling that of mustard, and which in fact is more or less characteristic of nearly all the members of the acryl series.

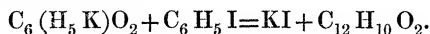
The analysis of acrylic alcohol has led to the formula



This compound is isomeric with acetone and with propyl-aldehyde, from which substances, however, it differs essentially by the aggregate of its properties.

Acrylic alcohol burns with a much more luminous flame than ordinary alcohol. It mixes in all proportions with water. Treated with potassium, it disengages hydrogen and is converted into a transparent gelatinous mass, which is the *acryl-term corresponding to potassium-alcohol*.

This potassium compound is violently attacked by iodide of acryl; a precipitate of iodide of potassium is thrown down, and a liquid is formed lighter than water, and insoluble in this fluid. This new substance corresponds to ordinary ether; its formation is illustrated by the following equation:—



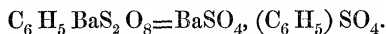
The same product is formed by the action of iodide of acryl upon oxide of silver or of mercury.

On treating the new potassium-alcohol with iodide of ethyl, or the ethyl-potassium-alcohol with iodide of acryl, an aromatic liquid is produced, which is obviously the *mixed ether of the ethyl and acryl series*.

If acrylic alcohol be distilled with chloride, bromide or iodide of

phosphorus, the *chloride*, *bromide* and *iodide of the acryl series* are reproduced with the greatest facility.

Acrylic alcohol dissolves in concentrated sulphuric acid, without separation of carbon; the liquid, mixed with water and neutralized with carbonate of barium, furnishes a crystalline salt, which contains,



This is the *sulphovinate of the series*.

On treating the mixture of acrylic alcohol with concentrated sulphuric acid, a most violent reaction takes place; the alcohol is entirely carbonized with evolution of sulphurous acid.

Anhydrous phosphoric acid affects the alcohol with less energy. The mass darkens with evolution of a transparent colourless gas, burning with a luminous flame. The analysis of this gas remains to be made.

Acrylic alcohol is rapidly attacked by oxidizing agents. A mixture of sulphuric acid and bichromate of potassium acts with tremendous violence; the products of the reaction being acrolein and acrylic acid, or its products of decomposition. The same transformation is effected by spongy platinum.

When treated with potassa and bisulphide of carbon, the new alcohol solidifies at once into a mass of splendid yellow needles, which correspond to xanthate of potassium.

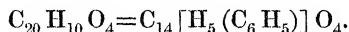
By the aid of the alcohol itself, its sulphovinic acid, or its iodide, all the terms of the acryl series may be produced with the greatest facility. We will specify the following compounds, the study of which we have more or less completed.

Acryl-oxamethane, or *oxamate of acryl*, is readily formed by adding alcoholic ammonia in small quantities to oxalate of acryl, until a permanent precipitate is produced. The filtered solution deposits on evaporation the oxamate in magnificent crystals.

Carbonate of acryl is an aromatic oily liquid, lighter than water. It is formed like the other carbonic ethers, by the action of sodium upon the oxalate. An alcoholic solution of this substance, when treated with baryta, furnished carbonate of barium and acrylic alcohol.

Benzoate of acryl is readily produced by the action of chloride of benzoyl upon acrylic alcohol. It is a liquid heavier than water,

which boils at 220° , and possesses an aromatic odour, similar to that of benzoic ether. The analysis of this substance leads to the formula

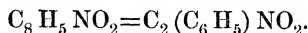


The same body is easily produced by the mutual reaction of iodide of acryl and benzoate of silver.

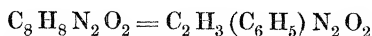
Acetate of acryl, obtained by the action of iodide of acryl upon acetate of silver, is a liquid lighter than water, of an odour resembling that of common acetic ether. According to our analysis, it contains



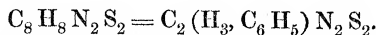
Cyanate of silver is most violently attacked by iodide of acryl, even in the cold. The heat generated during this reaction is so powerful that the whole of the new product distils over. The substance thus obtained has an incredibly penetrating odour, and causes lacrymation in the highest degree. The analysis of this colourless transparent liquid, which boils at 82° , led to the formula



This is the *cyanate of acryl*. Gently warmed with a solution of ammonia, this liquid readily dissolves, and the solution deposits upon evaporation magnificent crystals, which are nothing but acrylic urea

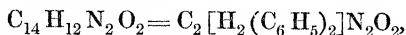


corresponding to thiosinnamine, the long-known sulphur-urea term of this series,

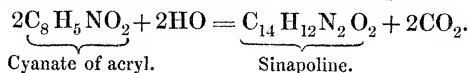


Aniline produces with cyanate of acryl an analogous substance, which crystallizes remarkably well.

When treated with water, cyanate of acryl is gradually converted into a solid crystalline substance. The compound obtained in this manner has the composition and all the properties of *sinapoline* or *diacrylic urea*. Its formula is



and its formation is illustrated by the following equation:—



Cyanate of acryl is decomposed by a concentrated solution of

potassa ; a solid substance is rapidly formed, which floats upon the surface of the solution, and which is nothing but the same sinapoline, whilst a strongly alkaline liquid passes into the receiver, which is a mixture of several bases, in which we have traced already

- (1) Methylamine.
- (2) Propylamine.
- (3) Acrylamine.

The latter substance boils between 180° and 190° . All our attempts to produce a well-crystallized platinum-salt of this base have hitherto failed.

The experiments detailed in the preceding sketch incontestably demonstrate the existence of a new series of alcohols, the third term of which is acrylic alcohol.

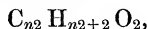
Like ordinary alcohol, this new alcohol furnishes a series of derivatives, which may be formulated in a similar manner.

The following tables exhibit the terms of the acryl series hitherto prepared in juxtaposition with the corresponding members of the ethyl series :—

Acryl Terms.		Ethyl Terms.	
$C_6 H_6 O_2$	Alcohol	$C_4 H_6 O_2$	
$C_6 H_5 O$ or	} Ether	{ $C_4 H_5 O$ or	
$C_{12} H_{10} O_2$			$C_8 H_{10} O$
$C_6 H_5 Cl$	Chloride	$C_4 H_5 Cl$	
$C_6 H_5 Br$	Bromide	$C_4 H_5 Br$	
$C_6 H_5 I$	Iodide	$C_4 H_5 I$	
$C_6 H_5 S$ or	} Sulphide	{ $C_4 H_5 S$ or	
$C_{12} H_{10} S_2$			$C_8 H_{10} S_2$
$C_2 (K, C_6 H_5) S_4 O_2$	Xanthate of potassium	$C_2 (K, C_4 H_5) S_4 O_2$	
$C_2 (C_6 H_5) NS_2$	Sulphocyanide	$C_2 (C_4 H_5) NS_2$	
$C_2 (C_6 H_5) NO_2$	Oxycyanide or cyanate	$C_2 (C_4 H_5) NO_2$	
$C_2 (H_3 C_6 H_5) N_2 S_2$	} Sulphuretted acryl- urea—Thiosinamine } ?		
$C_2 (H_3, C_6 H_5) N_2 O_2$		Acryl-urea, Ethyl-urea	$C_2 (H_3, C_4 H_5) N_2 O$
$C_2 [H_2 (C_6 H_5)_2] N_2 O_2$	} Diacryl-urea, Diethyl- sinapoline-urea }	{ $C_2 [H_2 (C_6 H_5)_2] N_2 O_2$	
$C_2 (C_6 H_5) O_4$ or			} Oxalate
$C_4 (C_6 H_5)_2 O_8$	$C_4 (C_4 H_5)_2 O_8$		
$C_4 H_2 (C_6 H_5) O_4$	Oxamate	$C_4 (H_2, C_4 H_5) O_6$	

Acryl Terms.		Ethyl Terms.
$C(C_6H_5)O_3$ or	} Carbonate	$C(C_4H_5)O_3$ or
$C_2(C_6H_5)_2O_6$		$C_2(C_4H_5)_2O_6$
$C_4H_3(C_6H_5)O_4$	Acetate	$C_4(H_3, C_4H_5)O_4$
$C_{14}H_5(C_6H_5)O_4$	Benzoate	$C_{14}H_5(C_4H_5)O_4$
$C_6H_5SO_4HSO_4$	Sulphovinic acid ..	$C_4H_5SO_4HSO_4$
$(C_6H_5)H_2N$	} Acrylamine, Ethyl- amine	} $(C_4H_5)H_2N$
	Aldehyde.	
$C_6H_4O_2$	} Acrylic, Ethylic, Acroleine	} $C_4H_4O_2$
	Acid.	
$C_6H_4O_4$	} Acrylic; acetic	} $C_4H_4O_4$
	Hydrocarbon.	
C_6H_6	} Propylene?, Acetene }	} C_4H_6

Acrylic alcohol, the history of which we have endeavoured to sketch in the preceding pages, and in the study of which we are now engaged, is the third term of a series of alcohols, which is parallel to the ordinary alcohols of the formula



and the prototype of which is ethylic alcohol. The acid corresponding to this alcohol is acrylic acid, as has been stated. Chemists are already acquainted with several homologues of acrylic acid, which stand to the series of fatty acids in the same relation which exists between our new alcohol and common alcohol. Cyanide of acryl, which is readily procured by the action of iodide of acryl upon cyanide of silver, but which as yet we have not been able to obtain in a state of perfect purity, when submitted to the action of potassa, will obviously furnish an acid, homologous to acrylic acid equally as cyanide of propyl is transformed into butylic acid.

We terminate this note with a synoptical table of the two homologous groups.

Group of Alcohols.			Group of Acids.		
$C_2H_2O_2$	$C_2H_4O_2$	Methylic	C_2O_4	(Carbonic?)	$C_2H_2O_4$ Formic
$C_4H_4O_2$	$C_4H_6O_2$	Ethylic	$C_4H_2O_4$		$C_4H_4O_4$ Acetic
$C_6H_6O_2$	$C_6H_8O_2$	Propylic	$C_6H_4O_4$	Acrylic	$C_6H_6O_4$ Propionic
$C_8H_8O_2$	$C_8H_{10}O_2$	Butylic	$C_8H_6O_4$	Angelic	$C_8H_8O_4$ Butylic
$C_{10}H_{10}O_2$	$C_{10}H_{12}O_2$	Amylic	$C_{10}H_8O_4$		$C_{10}H_{10}O_4$ Valeric
$C_{12}H_{12}O_2$	$C_{12}H_{14}O_2$	Caproic	$C_{12}H_{10}O_4$		$C_{12}H_{12}O_4$ Caproic
$C_{14}H_{14}O_2$	$C_{14}H_{16}O_2$		$C_{14}H_{12}O_4$		$C_{14}H_{14}O_4$ Ceananthylic
$C_{16}H_{16}O_2$	$C_{16}H_{18}O_2$	Caprylic	$C_{16}H_{14}O_4$		$C_{16}H_{16}O_4$ Caprylic
<hr/>	<hr/>		<hr/>		<hr/>
$C_{36}H_{36}O_2$	$C_{36}H_{38}O_2$		$C_{36}H_{34}O_4$	Oleic	$C_{36}H_{36}O_4$ Stearic

This table exhibits a considerable number of gaps, which the progress of science will not be long in filling up. Even now we have established by experiment that bromide of amylenes suffers many changes, which are perfectly analogous to those which we have witnessed in the acryl series, and even the derivatives of olefiant gas appear to exhibit in many respects an analogous deportment.

February 14, 1856.

Dr. W. A. MILLER, V.P., in the Chair.

The following communication was read :—

“On Periodical Laws discoverable in the Mean Effects of the larger Magnetic Disturbances.”—No. III. By Colonel EDWARD SABINE, R.A., D.C.L., Treas. and V.P.R.S.

(Abstract.)

In two previous papers bearing the same title as the present (Phil. Trans. 1851, Art. V., and 1852, Art. VIII.), the author showed, from the hourly observations of the magnetic Declination at Toronto and Hobarton, that the magnetic disturbances of large amount, and apparently irregular occurrence, commonly called *magnetic storms*, are found, when studied in their *mean* effects, to be governed by periodical laws of systematic order and regularity, and to exhibit periods whose duration is, respectively, 1, a solar day; 2, a solar year; and 3, a period of about ten of our solar years, corresponding both in duration and in the epochs of maximum and minimum variation, to the approximately decennial period discovered by Schwabe in the phænomena of the solar spots. In the present paper the author communicates the results of a similar investigation into the laws of the disturbances of the two other magnetic elements at Toronto, namely, the Inclination and the Total Force, derived from the hourly observations of the horizontal and vertical Forces during the five years from July 1843 to June 1848; affording, as he states, a full confirmation of the existence of periodical laws regulating the disturbances of the Inclination and Total Force corresponding to those which he had previously deduced from the disturbances of the other magnetic Element, viz. the Declination.