

acids are distinguished from the aromatic analogues by their greater solubility in water. In all cases they are most advantageously prepared by reacting with one equivalent of hydrazine hydrate upon the ester of the acid rather than upon the free acid itself. The esters of dibasic fatty acids react analogously with two equivalents of hydrazine hydrate, producing hydrazides which contain two NHNH groups.

Formic hydrazide, HCO.NHNH_2 , is produced when molecular equivalents of ethyl formate and hydrazine hydrate are mixed, considerable evolution of heat occurring. When the product is allowed to stand in a vacuum for some days large tubular crystals of the pure compound separate. The crystals are transparent, very hygroscopic, and extremely soluble in water, alcohol, ether, chloroform, and benzene. They melt at 54° . Formic hydrazide does not form salts with acids; even dilute acids at once decompose it in the cold with formation of formic acid and a salt of hydrazine. The solution of the crystals in water reduces Fehling's solution and ammoniacal silver nitrate readily at the ordinary temperature. Formic hydrazide forms a crystalline compound with benzaldehyde with considerable rise of temperature and with elimination of water. The crystals of the compound, benzalformyl-hydrazine, $\text{HCO.NH.N : CH.C}_6\text{H}_5$, melt at 134° . When excess of ethyl formate is heated with hydrazine hydrate in a sealed tube to 100° – 130° for some hours, another formic hydrazide, diformyl-hydrazine HCO.NH.NH.CO.H , is produced in the form of brilliant colourless prisms an inch or more in length. In the preparation of this beautiful compound care must be taken to strongly cool the tube during the filling with the two components, as their interaction is otherwise of a dangerously energetic character. The crystals of diformyl-hydrazine are very soluble in water, but difficultly so in alcohol, and practically insoluble in ether. They melt at 159° , and reduce ammoniacal silver solution upon warming. Dilute sulphuric acid decomposes them as readily as those of formic hydrazide into formic acid and hydrazine sulphate.

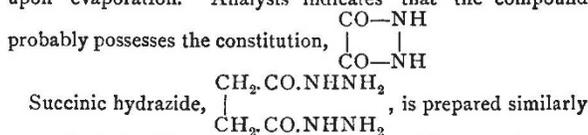
Acetic hydrazide, $\text{CH}_3\text{CO.NH.NH}_2$, is prepared by warming equivalent quantities of acetic ether and hydrazine hydrate in a sealed tube for a few hours at the temperature of a water-bath. The product rapidly solidifies in a desiccator to a white mass of crystals. The crystals are colourless needles aggregated in leaves, and melt at 62° . They deliquesce rapidly on exposure to moist air, and are also very soluble in cold alcohol. The aqueous solution reacts neutral to litmus, and is readily decomposed into the original component substances by either acids or alkalis. The compound cannot be distilled without decomposition. The solution reduces Fehling's solution very vigorously on warming. Like the formic compound, acetic hydrazide reacts with benzaldehyde to produce an analogous crystalline compound, acetyl-benzal-hydrazine, $\text{CH}_3\text{CONHN : CHC}_6\text{H}_5$.

Oxalic hydrazide, CO.NH.NH_2 , is produced by the action of two molecular equivalents of hydrazine hydrate upon ethyl oxalate. The reaction is a somewhat violent one, and is best moderated by the addition of a little alcohol.

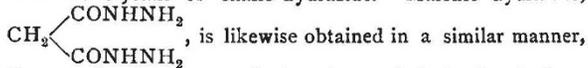
The new compound separates as a white crystalline mass, which is much less soluble in water than the hydrazides of the monobasic acids, and is almost insoluble in alcohol and ether. It is deposited from solution in hot water in very long and thick needles, which decompose at 235° . The solution reduces Fehling's or ammoniacal silver solution much less vigorously than the monobasic compounds. Oxalic hydrazide is much more stable towards acids and alkalis than the last-mentioned substances. The compound may be recrystallised unchanged from dilute sulphuric acid, and concentrated sulphuric and hydrochloric acids only decompose it very slowly. If, however, concentrated hydrochloric acid is allowed to drop upon the powdered substance moistened with water, until the acid is in slight excess, a white crystalline powder is obtained which is found to consist of the hydrochloride of the hydrazide, $\text{CO.NH.NH}_2\text{HCl}$.

Oxalic hydrazide reacts in an interesting manner with nitrous acid (sodium nitrite and glacial acetic acid); an energetic evolution of gas occurs, and a white powder separates. The same white substance may be obtained by acting upon oxalic hydrazide suspended in water with mercuric oxide, and decomposing the mercury compound produced with sulphuretted hydrogen, the filtrate depositing the white powder

upon evaporation. Analysis indicates that the compound probably possesses the constitution,

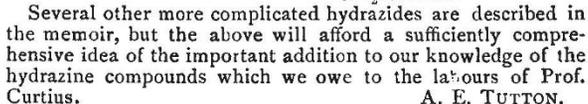


to oxalic hydrazide, and crystallises in silver-like crystal aggregates which melt at 167° , and which are more soluble in water than the crystals of oxalic hydrazide. Malonic hydrazide,



the reaction between malonic ether and hydrazine hydrate being very vigorous even in the cold. The crystals melt at 152° . The aqueous solution reduces Fehling's solution, ammoniacal silver solution, and platinum chloride at the ordinary temperature. Both the succinic and malonic hydrazides are as stable towards acids as the oxalic compound, and each yields a hydrochloride with concentrated hydrochloric acid. Both hydrochlorides are obtained in the form of small crystals, and they melt at 203° and 197° respectively with violent evolution of gas. Succinic hydrazide reacts with nitrous acid to form an interesting compound analogous to that of oxalic hydrazide.

Its simplest possible constitution is



A. E. TUTTON.

THE AURORA OF MARCH 13.

A NUMBER of letters referring to an aurora observed on March 13, have reached us. We select from these communications a few details of value and interest.

Writing from York, Mr. J. Edmund Clark says:—

"I was in a position for observing at 9.10; the display finally ended soon after 10. The latter part was seen, very similarly, at Scarborough, 9.10. Arch, pure white (and so all through) just north of zenith; east end brighter, with well-defined, beak-like apex upon α Coronæ borealis (alt. 17° , az. 13° north of east). Upper edge just grazed ζ and η Ursæ majoris, the lower some 3° below Polaris, a little west of which it became double, the Pleiades lying in the fork, 5° or 10° from the finish at about altitude 20° or 25° , nearly due west. No auroral glow outside, nor later, except as stated. The outer curves, west end, would have met, if continued, in similar "beak" as at east end.

"9.15.¹ Lower edge through β Ursæ minoris, Polaris, and α Persei. Streamers now traversing rapidly from east to west, pointing to magnetic anti-pole; passed from η Ursæ majoris to Polaris in 25 to 30 seconds by watch. Constant succession, as bars of light, for some minutes; then temporary cessation, but later intermittent, until 9.45. These were entirely distinct, as is obvious, from the ordinary far more rapid flickering from horizon to magnetic anti-pole. Three rough positions of stationary forms near the Plough, Auriga, and Jupiter, projected on the B.A. Meteor Star Chart, cross at altitude $68\frac{1}{2}^\circ$, azimuth 35° ($\frac{1}{4}^\circ$ and 6° respectively from the true magnetic anti-pole, for York, at $68\frac{1}{4}$ and 18°).

"9.25. Streamers, often as curtain-like fringe on lower edge of arch, now less prominent. Others still streaming from east to west in the arch show no perceptible effect as they sweep by these. New set moved slowly westward, about 1° or 2° per minute.

"9.30. Lower edge again as at 9.25. Upper edge had covered Plough; arch double more or less entirely; varies fast; much fainter to east from 9.25.

"9.37. Lower edge through handle of Plough, Capella, 1° north of Mars and $\frac{3}{4}$ on from Mars to horizon. Fringe below now brilliant, but rapid fluctuations.

"9.45. Brilliant short streamers in fringe, from Mars to α Aurigæ, and $\frac{1}{2}$ on to Polaris.

"10.0. All gone but one long faint streamer from 3° to left

¹ If others have thought of recording positions at the exact quarters, some altitudes might be obtained from the four given here.

of Aldebaran up to 1° to left of Jupiter, moving slowly westwards as before."

Mr. G. W. Lamplugh observed the display at Ramsay, Isle of Man, and to him the chief feature was "the predominance of a well-defined luminous bar extending across the heavens directly overhead from one horizon to the other—from magnetic east to west.

"The stars shone through this band of pale light with scarcely diminished brightness, but it was occasionally flecked by thin clouds. When I first saw it, at 9:20 p.m., there seemed to be traces of oblique striation crossing it, and Dr. Teller, who called my attention to the display, states that ten minutes earlier, when the bar was at its brightest, these striations gave the effect of slightly twisted folds. Another informant remarked that the bar was formed shortly before 9 p.m. by the union overhead of rays which shot upwards for the east and west.

"The light waned rather rapidly with slight pulsations, and we thought that we could detect a slow southerly drift in the band before it vanished. The western portion died out before the eastern, which remained quite definite until 9:45 p.m. Meanwhile there had been a faintly diffused illumination of the northern heavens, with occasional suggestions of radiant streamers, but the whole quite subordinate in brightness to the band overhead.

"There was a westerly breeze and a nearly clear sky, with a low cloud-bank in the north-west, at the commencement of the display, but before 9:45 p.m. the wind had backed southward, and shortly afterwards the sky became suddenly overcast, though not before the aurora had faded to a scarcely perceptible glow. Half an hour later a slight shower fell."

The Rev. S. Barber says that the aurora was visible at Westnewton, Aspatia, in great brilliancy, as a band passing nearly over the zenith from the west to the east horizon at about 10 p.m. An arch of light was seen in the north from about 8.30, and some observers saw a shorter band almost north and south preceding the great band west and east.

Mr. J. Cuthbertson saw the display at Kilmarnock, N.B., as early as 7.45, "as a broad arch of light crossing the heavens from east to west. About 7.50 it was a very luminous pencil of light in the upper part of the heavens, through which stars of the second and third magnitude were distinctly visible. As it condensed it grew brighter. About ten minutes after I first observed it, it began to fade, and was invisible before 8 o'clock, leaving a temporary brightness in the western sky."

The aurora appears to have presented features very similar to those of the aurora of November 23, 1894, observations of which were discussed by Prof. A. S. Herschel in NATURE of January 10.

THE U.S. UNITS OF ELECTRICAL MEASURE.

BY a law approved in the Senate of the United States, last July, it was enacted that the legal units of electrical measure in the United States should be as follows:—

(1) The unit of resistance shall be what is known as the international ohm, which is substantially equal to one thousand million units of resistance of the centimetre-gram-second system of electromagnetic units, and is represented by the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice fourteen and four thousand five hundred and twenty-one ten-thousandths grams in mass, of a constant cross-sectional area, and of the length of one hundred and six and three-tenths centimetres.

(2) The unit of current shall be what is known as the international ampere, which is one-tenth of the unit of current of the centimetre-gram-second system of electromagnetic units, and is the practical equivalent of the unvarying current, which, when passed through a solution of nitrate of silver in water in accordance with standard specifications, deposits silver at the rate of one thousand one hundred and eighteen millionths of a gram per second.

(3) The unit of electromotive force shall be what is known as the international volt, which is the electromotive force that, steadily applied to a conductor whose resistance is one international ohm, will produce a current of an international ampere, and is practically equivalent to one thousand fourteen hundred and thirty-fourths of the electromotive force between the poles or electrodes of the voltaic cell known as Clark's cell, at a temperature of fifteen degrees Centigrade, and prepared in the manner described in the standard specifications.

(4) The unit of quantity shall be what is known as the international coulomb, which is the quantity of electricity transferred by a current of one international ampere in one second.

(5) The unit of capacity shall be what is known as the international farad, which is the capacity of a condenser charged to a potential of one international volt by one international coulomb of electricity.

(6) The unit of work shall be the Joule, which is equal to ten million units of work in the centimetre-gram-second system, and which is practically equivalent to the energy expended in one second by an international ampere in an international ohm.

(7) The unit of power shall be the watt, which is equal to ten million units of power in the centimetre-gram-second system, and which is practically equivalent to the work done at the rate of one Joule per second.

(8) The unit of induction shall be the Henry, which is the induction in a circuit when the electromotive force induced in this circuit is one international volt while the inducing current varies at the rate of one ampere per second.

The National Academy of Sciences was instructed to prescribe and publish the specifications necessary for the practical application of the definitions of the ampere and volt given in the foregoing, and, to meet this requirement of Congress, a special committee was appointed to consider the subject. The committee, selected from members of the Academy, was as follows:—Prof. H. A. Rowland, chairman, General H. L. Abbot, Prof. G. F. Barker, Prof. C. S. Hastings, Prof. A. A. Michelson, Prof. J. Trowbridge, Dr. Carl Barus.

The report of this committee was submitted to the Academy at a special meeting held last month, and was then accepted and unanimously adopted. We extract the following details from the report, a copy of which has just reached us.

The Ampere.

In employing the silver voltameter to measure currents of about one ampere, the following arrangements shall be adopted:—

The kathode on which the silver is to be deposited shall take the form of a platinum bowl not less than 10 centimetres in diameter, and from 4 to 5 centimetres in depth.

The anode shall be a disc or plate of pure silver some 30 square centimetres in area and 2 or 3 millimetres in thickness.

This shall be supported horizontally in the liquid near the top of the solution by a silver rod riveted through its centre. To prevent the disintegrated silver which is formed on the anode from falling upon the kathode, the anode shall be wrapped around with pure filter paper, secured at the back by suitable folding.

The liquid shall consist of a neutral solution of pure silver nitrate, containing about 15 parts by weight of the nitrate to 85 parts of water.

The resistance of the voltmeter changes somewhat as the current passes. To prevent these changes having too great an effect on the current, some resistance besides that of the voltmeter should be inserted in the circuit. The total metallic resistance of the circuit should not be less than 10 ohms.

Method of making a Measurement.—The platinum bowl is to be washed consecutively with nitric acid, distilled water, and absolute alcohol; it is then to be dried at 160°C ., and left to cool in a desiccator. When thoroughly cool it is to be weighed carefully.

It is to be nearly filled with the solution and connected to the rest of the circuit by being placed on a clean insulated copper support to which a binding screw is attached.

The anode is then to be immersed in the solution so as to be well covered by it and supported in that position; the connections to the rest of the circuit are then to be made.

Contact is to be made at the key, noting the time. The current is to be allowed to pass for not less than half an hour, and the time of breaking contact observed.

The solution is now to be removed from the bowl, and the deposit washed with distilled water, and left to soak for at least six hours. It is then to be rinsed successively with distilled water and absolute alcohol, and dried in a hot-air bath at a temperature of about 160°C . After cooling in a desiccator it is to be weighed again. The gain in mass gives the silver deposited.

To find the time average of the current in amperes, this mass, expressed in grams, must be divided by the number of seconds during which the current has passed, and by 0.001118.

In determining the constant of an instrument by this method.