L. GLYCINE AND ITS NEUTRAL SALT ADDITION COMPOUNDS.

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THE work of Bugarsky and Liebermann [1898] showed that proteins could combine with acids and alkalis but not with sodium chloride. It is not however universally accepted that no combination takes place between proteins and neutral salts in general. The behaviour of amino-acids, as forming the fundamental units of the protein molecule, towards neutral salts is therefore of some interest.

Scattered throughout the early literature, there are several references to the addition compounds of glycine and inorganic salts. It is, however, to Pfeiffer and his co-workers that we are indebted for a fuller and more systematic account of the addition products of neutral salts, particularly the halides of the alkali and alkaline earth metals with glycine, its simpler derivatives, and alanine.

By mixing glycine and the chlorides or bromides of the alkaline earth metals or of lithium in suitable proportions in aqueous solution Pfeiffer and Modelski [1912, 1913] obtained on evaporating the solution, or on adding alcohol, crystalline addition complexes, containing the components in some simple molecular proportion. Thus calcium chloride was found to furnish three compounds, $\text{CaCl}_2, \text{C}_2\text{H}_5\text{O}_2\text{N}, 3\text{H}_2\text{O}$; $\text{CaCl}_2, (\text{C}_2\text{H}_5\text{O}_2\text{N})_2, 4\text{H}_2\text{O}$, and $\text{CaCl}_2, (\text{C}_2\text{H}_5\text{O}_2\text{N})_3$ and lithium bromide two compounds, $\text{LiBr}, \text{C}_2\text{H}_5\text{O}_2\text{N}, \text{H}_2\text{O}$, and $\text{LiBr}, (\text{C}_2\text{H}_5\text{O}_2\text{N})_2, \text{H}_2\text{O}$. The formation and isolation of these pure substances were materially assisted by the addition to the clear solution of a little acetic acid. Bayliss [1915, 1919, 2] has on several occasions taken exception to the description of these addition products as compounds, his own preliminary experiments having indicated that the problem was more complex and involved the formation of mixed crystals.

One of the present authors, having had experience of addition compounds of the alkaline earth halides and also of the alkali metal halides with an amphoteric substance of quite a different type, it was decided to attempt to throw further light on these addition compounds of glycine under such conditions as would lead to results of significance. The addition of acetic acid

and precipitation by alcohol were therefore avoided throughout. We have, moreover, restricted the experiments to solutions containing one molecular proportion of glycine in the case of lithium, sodium and potassium chlorides, bromides and iodides, and two molecular proportions in the case of calcium strontium and barium chlorides and iodides, except where the behaviour of such a solution rendered it necessary to start with different proportions of the components.

In the main we confirm the results of Pfeiffer and Modelski with regard to the definite nature of the compounds of glycine with calcium, barium and strontium chlorides, of the type $MCl_2, (C_2H_5O_2N)_2, H_2O$, and with lithium chloride and bromide of the types, $LiCl$ (or Br), $C_2H_5O_2N, H_2O$ and $LiCl$ (or Br), $(C_2H_5O_2N)_2, H_2O$. We have been unable to prepare any addition compounds of the potassium halides, but have succeeded in preparing from sodium bromide and iodide, addition compounds of the same type as the second lithium type figured above. We are also able to support Bayliss's contention of the formation of solid solutions, which in our opinion are formed by the mutual solubility of the addition compounds in one another.

The different degrees of complexity of behaviour over the somewhat restricted range of composition of the solutions as studied by us are shown by the following examples.

Barium chloride and glycine form a compound, $BaCl_2, (C_2H_5O_2N)_2, H_2O$, which can be obtained pure from a solution containing the components in widely differing molecular proportions.

Ratio $BaCl_2/C_2H_5O_2N$	1 : 2	3 : 4	1 : 4
% yield of $BaCl_2, (C_2H_5O_2N)_2, H_2O$	60	64	48
Analysis	Cl=18.8 N = 7.6	Cl=18.8 N = 7.5	Cl=18.7 N = 7.7

Calculated for $BaCl_2, (C_2H_5O_2N)_2, H_2O$; Cl=18.8; N=7.4 %.

This table furnishes a proof of the true molecular compound nature of these addition products. Moreover, the water of crystallisation present in all of these addition compounds is in some simple molecular proportion and is not the same as is present in the pure inorganic constituent, when in equilibrium with its saturated solution at the ordinary room temperature.

The behaviour of lithium bromide and glycine is of interest as it affords evidence that perfect homogeneity of crystalline appearance is not in itself a sufficient criterion of a definite chemical compound. A solution of these components in molecular proportions deposits on concentration first well-formed transparent needles, which are soon followed by a voluminous deposit of smaller white needles. If the transparent needles be collected before the second type has appeared, their Br/N ratio is approximately 0.87/1. This ratio is intermediate between the two compounds, $LiBr, C_2H_5O_2N, H_2O$ and $LiBr, (C_2H_5O_2N)_2, H_2O$, which were obtained by Pfeiffer and Modelski and have also been obtained by us, and the crystals represent a solid solution of the one compound in the other.

The iodides of calcium, strontium and barium when crystallised from a solution containing two molecular proportions of glycine do not give pure compounds. The crystals are generally poor in appearance when compared with the corresponding chlorides, and probably represent solid solutions of more or less complete miscibility. From the mother liquor of such a calcium iodide—glycine solution, which, having already deposited crystals whose I/N ratio was 0.57/1, was relatively richer in calcium iodide, the most markedly crystalline compound yet encountered in these experiments was obtained. It crystallised in large tablets of the composition, $\text{CaI}_2 \cdot (\text{C}_2\text{H}_5\text{O}_2\text{N})_2 \cdot 3\text{H}_2\text{O}$. These were shown to be stable only in contact with solutions containing excess of calcium iodide. This behaviour is strictly analogous to the well-known instability of carnallite, $\text{KCl} \cdot \text{MgCl}_2 \cdot 6\text{H}_2\text{O}$ except in contact with solutions containing excess of magnesium chloride.

Lithium iodide and glycine in molecular proportions did not furnish a pure homogeneous compound.

From aqueous glycine solutions or from solutions of glycine containing neutral salts, we have repeatedly isolated an unstable form of glycine crystallising in long stout needles or columns. On keeping in contact with the solution these gradually disappear with simultaneous deposition of the oft-described and pictured, squat monoclinic crystals [Schmelcher, 1892]. Curtius [1882] seems to have observed the formation of these two kinds of crystal from aqueous solution, but did not recognise their relative stability. The remarkable experiments of Ostromisslenski [1908] on the inoculation of *dl*-asparagine solutions with glycine, to explain which he postulates the existence of two enantiomorphous forms of glycine and moreover states that glycine crystallises in the rhombic hemihedral system and not in the monoclinic, may be intimately connected with the existence of the two forms observed by us. Fischer [1905] obtained a form of glycine which was reactive towards phosphorus pentachloride by precipitating its aqueous solution with alcohol. This form we consider to be probably identical with our unstable form from aqueous solutions. Falk and Sugiura [1918], repeating Fischer's preparation, showed that this reactive form, precipitated by alcohol in the form of fine needles, differed from the ordinary form in its greater absorption of bromine in the dry state and in its slightly slower evolution of gas in the determination of the van Slyke values. The difference in behaviour in the region of the melting point as described by these authors we have shown to be independent of any difference of structure. To account for these two glycines they suggest as a possibility a difference of structure, $\text{NH}_2 \cdot \text{CH}_2 \cdot \text{COOH}$ and $\overline{\text{NH}_3 \cdot \text{CH}_2 \cdot \text{COO}}$.

It is of interest that in reviewing the nature of the linking of affinities in these addition compounds, Pfeiffer and Wittka [1915] reject the view expressed in the earlier paper of Pfeiffer and Modelski that the addition compounds were amphi-salts of the type $\text{LiOOC} \cdot \text{CH}_2 \cdot \text{NH}_2 \cdot \text{HCl}$ and now suppose that

the metal portion of the inorganic salt is attached to the closed ring form of glycine by means of the residual affinity of the carbonyl group, *e.g.* ClM...

EXPERIMENTAL DETAILS.

Glycine Addition Compounds of Calcium, Strontium and Barium Chlorides.

Barium Chloride. 5 grams of glycine ester hydrochloride were boiled for about 45 minutes with 20 cc. of water and 5 g. of barium carbonate. The solution was then filtered and on concentration yielded well-formed transparent plates. The first and second crops possessed a perfectly homogeneous appearance and amounted respectively to 2.3 and 1.2 g. The air-dried substance was analysed.

0.2033; 0.1557 g. AgCl. Cl=18.9 %.

0.2982; NH_3 equivalent to 16.08 cc. *N*/10 acid. N=7.6 %.

0.1981 dried at 120° lost 0.0103 g. H_2O =5.2 %.

Calculated for $\text{BaCl}_2 (\text{C}_2\text{H}_5\text{O}_2\text{N})_2$, H_2O ; Cl=18.8; N=7.4; H_2O =4.8 %.

The same compound was obtained from a mixture of one molecule of barium chloride and two molecules of glycine. Thus 1 g. of glycine and 13.9 cc. of 10 % barium chloride solution gave on concentration 1.5 g. (60 % yield) of addition compound crystallising in stout needles.

0.2092 g. air-dry; 0.1586 g. AgCl. Cl=18.8 %.

0.2089 g. air-dry; NH_3 equivalent to 11.28 cc. *N*/10 acid. N=7.6 %.

When the proportion of barium chloride was increased to three molecules to four of glycine, the same compound was isolated pure. One gram of glycine gave 1.6 g. (64 % yield) of addition compound.

0.2045 g. air-dry; 0.1557 g. AgCl. Cl=18.8 %.

0.2045 g. air-dry; NH_3 equivalent to 11.01 cc. *N*/10 acid. N=7.5 %.

When, however, the proportion of barium chloride was decreased to one molecule to four molecules of glycine, crystals of the addition compound separated followed by free glycine. By filtration before the glycine crystals began to appear, 1.2 g. (48 % yield) of pure addition compound were obtained from 2 g. of glycine.

0.2017 g. air-dry; 0.1522 g. AgCl. Cl=18.7 %.

0.2021 g.; NH_3 equivalent to 11.06 cc. *N*/10 acid. N=7.7 %.

Calcium Chloride. When the preparation of the calcium and strontium addition compounds of glycine was attempted starting with glycine ester hydrochloride and excess of calcium or strontium carbonates it was unexpectedly found that after prolonged boiling there was only slight decomposition of the ester hydrochloride, for on concentrating, the first crop of crystals consisted in each case of pure glycine ester hydrochloride, crystallising in the characteristic long silky needles, melting about 140° and analysing correctly. (Found Cl = 25.3; N = 10.0; 9.9; $\text{C}_4\text{H}_9\text{O}_2\text{N}$, HCl requires Cl = 25.4; N = 10.0 %.)

The required addition compound was readily obtained by boiling the ester hydrochloride of glycine with excess of halogen-free slaked lime, filtering, saturating with carbon dioxide and further boiling to decompose the bicarbonate and carbamate formed. The calcium chloride addition compound crystallised in prismatic needles.

0.1995 g. air-dry; 0.1700 g. AgCl. Cl=21.1 %.

0.2023 g. air-dry; NH_3 equivalent to 12.06 cc. $N/10$ acid. N=8.3 %.

Calculated for $\text{CaCl}_2 \cdot (\text{C}_2\text{H}_5\text{O}_2\text{N})_2 \cdot 4\text{H}_2\text{O}$; Cl=21.3; N=8.4 %.

Strontium Chloride. The strontium chloride addition compound crystallised similarly in prismatic needles.

0.2044 g. air-dry; 0.1573 g. AgCl. Cl=19.0 %.

0.2030 g. air-dry; NH_3 equivalent to 11.12 cc. $N/10$ acid. N=7.7 %.

Calculated for $\text{SrCl}_2 \cdot (\text{C}_2\text{H}_5\text{O}_2\text{N})_2 \cdot 3\text{H}_2\text{O}$; Cl=19.5; N=7.7 %.

The somewhat divergent chlorine value was accidental, for, on recrystallisation, the compound gave the following figures on analysis.

0.2053 g. air-dry; 0.1613 g. AgCl. Cl=19.4 %.

0.2033 g. air-dry; NH_3 equivalent to 11.10 cc. $N/10$ acid. N=7.6 %.

0.2381 g. dried at 140° lost 0.0356 g. H_2O =15.0 %. (Theory requires 14.9 % H_2O .)

Glycine Addition Compounds of Calcium, Strontium and Barium Iodides.

Barium Iodide. An aqueous solution of two molecular proportions of glycine to one of barium iodide was concentrated under reduced pressure to a small volume. It deposited, when cold, a felted mass of woolly needles. On analysis the I/N ratio showed it to be a mixture.

0.2049 g. air-dry; 0.1508 g. AgI. I=39.8 %.

0.2054 g. air-dry; NH_3 equivalent to 9.8 cc. $N/10$ acid. N=6.7 %.

Whence $I/N=0.65/1$.

Strontium Iodide. Glycine (two molecular proportions) and strontium iodide gave a felted mass of crystals. Analysis indicated a mixture.

0.2031 g. air-dry; 0.1496 g. AgI. I=39.8 %.

0.2073 g. air-dry; NH_3 equivalent to 12.46 cc. $N/10$ acid. N=8.4 %.

Whence $I/N=0.52/1$.

Calcium Iodide. Glycine and calcium iodide were mixed in aqueous solution in the proportion of two molecules of glycine to one of calcium iodide. On concentration under reduced pressure and keeping at room temperature clusters of small needles were deposited. These were collected, air-dried and analysed.

0.2029 g.; 0.1674 g. AgI. I=44.6 %.

0.2013 g.; NH_3 equivalent to 12.4 cc. $N/10$ acid. N=8.6 %.

Whence $I/N=0.57/1$.

This sample was recrystallised from water and separated in small needles. The air-dry substance was analysed.

0.2021 g.; 0.1603 g. AgI. I=42.9 %.

0.2013 g.; NH_3 equivalent to 13.96 cc. $N/10$ acid. N=9.7 %.

Whence $I/N=0.49/1$.

In spite of the apparently satisfactory atomic ratio the crystals do not, probably, represent a pure individual compound.

The first mother liquors, after further concentration, deposited a felted mass of needles, but after standing for three or four weeks these had almost completely dissolved with deposition of large clear tablets. These were carefully picked out and analysed.

0.2040 g. air-dry; 0.1922 g. AgI. I=50.9 %.

0.2063 g. air-dry; NH_3 equivalent to 8.55 cc. *N*/10 acid. N=5.8 %.

Calculated for $\text{CaI}_2 \cdot (\text{C}_2\text{H}_5\text{O}_2\text{N})_2 \cdot 3\text{H}_2\text{O}$; I=51.0; N=5.6 %.

On keeping overnight the filtrate gave a further deposit of well-formed smaller tablets. These on analysis proved to be the same compound.

0.2010 g. air-dry; 0.1890 AgI. I=50.8 %.

0.2084 g. air-dry; NH_3 equivalent to 8.55 cc. *N*/10 acid. N=5.7 %.

With these crystals in hand a fresh calcium iodide solution containing two molecular proportions of glycine was prepared and concentrated. In spite of numerous attempts, inoculation with this well-formed crystalline trihydrate failed to cause any further separation of this form, the solution invariably yielding small needles. Nor did these change on prolonged keeping.

When, however, a solution of molecular proportions of glycine and calcium iodide was concentrated, inoculation with the trihydrate caused immediate separation of this compound.

0.2058 g. air-dry; 0.1919 AgI. I=50.4 %.

0.2046 g. air-dry; NH_3 equivalent to 8.44 cc. *N*/10 acid. N=5.8 %.

This compound is therefore only stable at room temperature in contact with solutions containing excess of calcium iodide.

Glycine Addition Compounds of the Lithium Halides.

Lithium Chloride. Glycine ester hydrochloride was boiled with an aqueous solution of one molecular proportion of lithium carbonate. On concentration the solution deposited, when cold, well-formed prismatic needles. When crystallisation of this form was almost complete a few crystals, smaller and opaque white in appearance, separated. The proportion of this latter was, however, quite small, and its effect is shown by the analysis of the total solid separation.

0.2059 g. air-dry; 0.2094 g. AgCl. Cl=25.2 %.

0.2034 g. air-dry; 0.2073 g. AgCl. Cl=25.2 %.

0.2015 g. air-dry; NH_3 equivalent to 15.61 cc. *N*/10 acid. N=10.8 %.

Calculated for $\text{LiCl} \cdot \text{C}_2\text{H}_5\text{O}_2\text{N} \cdot \text{H}_2\text{O}$; Cl=26.2; N=10.3 %.

It was recrystallised and separated in transparent prismatic needles of perfectly uniform appearance.

0.2013 g.; 0.2114 g. AgCl. Cl=26.0 %.

0.2073 g.; NH_3 equivalent to 15.53 cc. *N*/10 acid. N=10.5 %.

Lithium Bromide. A concentrated solution of molecular proportions of glycine and lithium bromide deposited first a crop of moderately long transparent needles, but before crystallisation was complete, a voluminous mass

of fine white needles separated as well. The total crop was collected and analysed when air-dry.

0.2021 g.; 0.1477 g. AgBr. Br=31.1 %.

0.2010 g.; NH_3 equivalent to 14.38 cc. $N/10$ acid. N=10.2 %.

Calculated for $\text{LiBr} \cdot (\text{C}_2\text{H}_5\text{O}_2\text{N})_2, \text{H}_2\text{O}$. Br=31.3; N=11.0 %.

A repetition of this experiment reproduced an identical behaviour.

Found on analysis, Br=32.9; N=10.6 %.

The experiment was now repeated, but the first crop of transparent needles, possessing all the apparent attributes of homogeneity, was collected before the second kind of crystal had begun to separate.

0.1767 g. air-dry; 0.1721 g. AgBr. Br=41.4 %.

0.1571 g. air-dry; NH_3 equivalent to 9.37 cc. $N/10$ acid. N=8.4 %.

Whence Br/N=0.87/1.

Two repetitions of this preparation in which the first, apparently homogeneous, separation of crystals was collected, gave similar figures on analysis.

Found Br=41.4; N=8.5. Whence Br/N=0.85/1.

Found Br=42.2; N=8.4. Whence Br/N=0.88/1.

In the presence of one-half a molecular proportion of lithium bromide in excess, a uniform crop of transparent prismatic needles was obtained. These were collected and analysed.

0.1943 g. air-dry; 0.2015 g. AgBr. Br=44.1 %.

0.2023 g. air-dry; NH_3 equivalent to 10.92 cc. $N/10$ acid. N=7.6 %.

Calculated for $\text{LiBr} \cdot \text{C}_2\text{H}_5\text{O}_2\text{N}, \text{H}_2\text{O}$. Br=44.4; N=7.8 %.

When the proportion of lithium bromide was reduced to three-fourths of a molecule, a crop of crystals was obtained possessing a homogeneous appearance and crystallising in transparent needles. This result was not obtained without some difficulty as the solution had to be heated up and allowed to crystallise several times before what were undoubtedly uniform crystals were obtained.

0.2001 g. air-dry; 0.1489 g. AgBr. Br=31.7 %.

0.2005 g. air-dry; NH_3 equivalent to 15.71 cc. $N/10$ acid. N=11.0 %.

Calculated for $\text{LiBr} \cdot (\text{C}_2\text{H}_5\text{O}_2\text{N})_2, \text{H}_2\text{O}$. Br=31.3; N=11.0 %.

When the proportion of lithium bromide was lowered still further, to one-half a molecule, it was not found possible to obtain a crop of crystals of homogeneous appearance. Pfeiffer and Modelski, using these proportions, admittedly after some difficulty, obtained tablets of the compound $\text{LiBr} \cdot (\text{C}_2\text{H}_5\text{O}_2\text{N})_2, \text{H}_2\text{O}$, which we obtained as described above, from a solution somewhat richer in glycine, but crystallising in needles.

Lithium Iodide. From a solution of molecular proportions of glycine and lithium iodide, clusters of fine white silky needles separated, not unlike the mixed crystals obtained from glycine and the iodides of the alkaline earth metals.

0.2017 g. air-dry; 0.1980 g. AgI. I=53.1 %.

0.2028 g. air-dry; NH_3 equivalent to 11.01 cc. $N/10$ acid. N=7.6 %.

Whence I/N=0.77/1.

A second experimental solution of molecular proportions was prepared and several attempts made to obtain uniform crystals of a different type, but without success.

Glycine Addition Compounds of the Sodium Halides.

Sodium Bromide. Glycine and sodium bromide in molecular proportions gave, on concentrating the solution, a homogeneous crop of well-defined transparent needles. These were collected and analysed.

0.2016 g.; 0.1442 g. AgBr. Br=30.4 %.

0.2023 g.; NH_3 equivalent to 15.09 cc. *N*/10 acid. N=10.4 %.

Calculated for $\text{NaBr}, (\text{C}_2\text{H}_5\text{O}_2\text{N})_2, \text{H}_2\text{O}$. Br=29.5; N=10.3 %.

A second solution was prepared with the same proportions, but considerable difficulty was experienced in obtaining a crop of crystals of homogeneous appearance. On inoculation, however, with the compound obtained in the first experiment, the same compound, crystallising in well-defined transparent needles, was obtained as before.

0.1562 g. air-dry; 0.1079 AgBr. Br=29.4 %.

0.1695 g. air-dry; NH_3 equivalent to 12.65 cc. *N*/10 acid. N=10.4 %.

Sodium Iodide. Glycine and sodium iodide in solution in molecular proportions gave, without difficulty, a crop of well-defined needles grouped in clusters.

0.2025 g. air-dry; 0.1501 g. AgI. I=40.0 %.

0.2007 g. air-dry; NH_3 equivalent to 12.63 cc. *N*/10 acid. N=8.8 %.

Calculated for $\text{NaI}, (\text{C}_2\text{H}_5\text{O}_2\text{N})_2, \text{H}_2\text{O}$. I=39.9; N=8.8 %.

A second solution of the same initial composition was prepared and on concentration readily gave the same compound.

0.1983 g.; 0.1463 g. AgI. I=39.9 %.

0.2028 g.; NH_3 equivalent to 12.59 cc. *N*/10 acid. N=8.7 %.

Sodium Chloride. Glycine ester hydrochloride was boiled in aqueous solution with one molecular proportion of anhydrous sodium carbonate. On concentration and allowing the solution to cool slowly or rapidly a mixture of crystals was invariably obtained, the glycine and sodium chloride separating side by side.

Glycine and Potassium Halides.

Using molecular proportions of glycine and one of the halides of potassium, namely chloride, bromide or iodide, no evidence was obtained of the formation of a crystalline addition compound. In one experiment with potassium bromide, a homogeneous crop of crystals was obtained. These contained a trace of halide, melted from 227–240°, and when analysed for nitrogen by the Kjeldahl process, proved to be practically pure glycine.

0.2026 g.; NH_3 equivalent to 26.58 cc. *N*/10 acid. N=18.4 %.

Calculated for $\text{C}_2\text{H}_5\text{O}_2\text{N}$. N=18.7 %.

Other Crystalline Forms of Glycine.

Glycine usually crystallises in compact crystals in the monoclinic system. When recrystallised from water, we have repeatedly observed the formation of another crystalline form of glycine, separating in long bold needles or columns and devoid of water of crystallisation. In one instance these were about two inches long. On keeping in contact with the solution, they invariably pass into the monoclinic variety, the unstable form gradually dissolving. The purest stable glycine that we have prepared decomposes in the neighbourhood of 256° (uncorr.). This temperature depends to a large extent on the rate of heating. There is also progressive darkening from about 240° onwards. The comparative behaviour of successively crystallised glycine is shown by the following table.

Crude glycine,	becomes pale brown,	about 220° ,	decomposes 240° .
Once crystallised	„ „ „ „	225° ,	„ 242° .
Twice	„ „ „ „	228° ,	„ 247° .
Thrice	„ „ „ „	235° ,	„ 254° .
Four times	„ „ „ „	240° ,	„ 256° .

Fischer's reactive glycine, precipitated by alcohol, prepared from the four times crystallised glycine, when compared side by side in the same bath with the stable form showed an identical behaviour. The observations of Falk and Sugiura ascribing a difference of range of progressive deepening of colour of the two forms on heating, the glycine precipitated by alcohol darkening over a shorter range by 10 to 20° , must therefore be due to the presence of extraneous impurity such as is present in the fewer times crystallised glycine shown above. Moreover, we had available a sample of glycine precipitated by alcohol, from some of which glycine acid chloride had been prepared by Fischer's method. When compared with our purest four times crystallised glycine it became progressively coloured several degrees in advance of the stable form and decomposed at 252° , whereas the stable form, heated in the same bath simultaneously, decomposed at 253° . This again is exactly the contrary of the behaviour described by Falk and Sugiura.

The unstable form from aqueous solution, which was prepared from a sample of pure glycine, when compared with the four times crystallised ordinary glycine, exhibited an identical behaviour.

SUMMARY.

1. The existence of the following addition compounds of glycine prepared by Pfeiffer and his co-workers is confirmed under severer experimental conditions. $\text{BaCl}_2, (\text{C}_2\text{H}_5\text{O}_2\text{N})_2, \text{H}_2\text{O}$; $\text{CaCl}_2, (\text{C}_2\text{H}_5\text{O}_2\text{N})_2, 4\text{H}_2\text{O}$; $\text{SrCl}_2, (\text{C}_2\text{H}_5\text{O}_2\text{N})_2, \text{H}_2\text{O}$; $\text{LiCl}, \text{C}_2\text{H}_5\text{O}_2\text{N}, \text{H}_2\text{O}$; $\text{LiBr}, (\text{C}_2\text{H}_5\text{O}_2\text{N})_2, \text{H}_2\text{O}$; $\text{LiBr}, \text{C}_2\text{H}_5\text{O}_2\text{N}, \text{H}_2\text{O}$.

2. The following new addition compounds are described. $\text{CaI}_2, (\text{C}_2\text{H}_5\text{O}_2\text{N})_2, 3\text{H}_2\text{O}$; $\text{NaBr}, (\text{C}_2\text{H}_5\text{O}_2\text{N})_2, \text{H}_2\text{O}$; and $\text{NaI}, (\text{C}_2\text{H}_5\text{O}_2\text{N})_2, \text{H}_2\text{O}$.

3. In agreement with Pfeiffer no compounds were obtained with the potassium halides or with sodium chloride.

4. An unstable form of glycine from aqueous solutions is described and its relationships discussed.

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