CCCLXIX.—*The Orienting Influence of Free and Bound Ionic Charges on Attached Simple or Conjugated Unsaturated Systems. Part II. The Nitration of* 1-*Benzylpiperidine and of Some Related Substances.*

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ALTHOUGH it is now generally agreed that the *m*-directive effect of the ammonium-salt group in the benzylammonium salts is associated with the positive charge of the ion, there are still many aspects of the subject that call for elucidation. The majority of the constitutive influences that have been observed in this field are susceptible of simple explanations, for example, the somewhat higher *m*-direction in $CH_2Ph{\cdot}NMe_2$ than in $CH_2Ph{\cdot}NEt_2$ (Goss, Ingold, and Wilson, J., 1926, 2440) is the result to be anticipated from the theory of Allan, Oxford, Robinson, and Smith (J., 1926, 401), the terminal methyl groups in the latter compound having a smaller electron affinity than the hydrogen atoms which they may be regarded as displacing. Thus in the benzyldiethylammonium ion the positive charge of the nitrogen atom is neutralised by electron displacement towards it to a larger extent than is the charge of the nitrogen atom in the benzyldimethylammonium ion. Considerations like these, although frequently applicable, cannot be extended, however, to benzylpiperidine, from which the yield of *m*-nitro-derivative is notably higher than that from the closely related tertiary bases already mentioned. Noelting and Kregczy (*Bull. Soc. chim.*, 1916, **19**, 355) found that benzyldiethylamine on nitration in sulphuric acid solution gave from 35—40% of the *m*-nitro-derivative; Flürscheim and Holmes (J., 1926, 1562) found 33—53% under various conditions in sulphuric acid solution. Goss, Ingold, and Wilson (*loc. cit.*), employing nitric acid (*d* 1·5) alone, found that the proportion of the *m*-isomeride formed was 51%, and we have confirmed this. On the other hand, we were aware that the estimate of the proportion of the *m*-nitro-isomeride formed in

the nitration of benzylpiperidine, that was based by Ing and Robinson (J., 1926, 1665) on the separation as hydriodide, namely 60%, was a conservative one. Employing Francis and Hill's bromination method (*J. Amer. Chem. Soc.*, 1924, **46**, 2498), we find that 72% of *m*-nitrobenzylpiperidine is actually formed. Similarly, 1-β-*phenylethylpiperidine*, $C_5H_{10}N{\cdot}CH_2{\cdot}CH_2Ph$, obtained by the interaction of magnesium benzyl chloride and *N-iso*butoxymethylpiperidine in accordance with the general method of Robinson and Robinson (J., 1923, **123**, 532), gave on nitration about 22% of its *m*-nitro-derivative. This figure is higher than that found for the simpler dialkylated β-phenylethylamines (compare Goss, Hanhart, and Ingold, J., 1926, 250) and confirms the benzylpiperidine case. We are aware that this pronounced effect of ring closure may be accounted for merely as the result of a composition difference of two hydrogen atoms, our knowledge being insufficient to enable us to exclude this possibility on *a priori* grounds; we are nevertheless of the opinion that such a simple view is inadequate and, in the sequel, propose an alternative.

Flürscheim and Holmes (*loc. cit.*) showed that the proportion of *m*-nitrobenzyldiethylamine formed in the nitration of the salt of the base in sulphuric acid was diminished by saturation of the solution with ammonium sulphate. We have extended the study of this phenomenon to the nitration of benzylpiperidine in nitric acid solution. The addition of ammonium nitrate reduced the proportion of *m*-isomeride formed to about 56%, but as this salt is not readily soluble in nitric acid we made a further series of experiments on the influence of the addition of trimethylammonium nitrate to the acid, and found that the proportion of *m*-isomeride formed could be reduced to 16%. Addition of rubidium nitrate, which is readily soluble in nitric acid, produced roughly the anticipated effect. Addition of urea also decreased the proportion of the *m*-isomeride formed, and this was due to Flürscheim's effect and not to the removal of nitrous acid, because when nitric acid freed from nitrous acid by means of lead peroxide or by hydrogen peroxide was employed for the nitration of benzylpiperidine the normal proportion of the *m*-isomeride was formed.

These variations in orientation produced by the addition of salts are unexpectedly great and demonstrate that the condition of the kation is of primary importance in determining the nature of the observed results. We attribute the effect to the progressive electrostriction of the kations by the nitrate ions, an explanation which is the equivalent, in the modern theory, of Flürscheim and Holmes's suggestion that the ion undergoes substitution in the *m*-position and the undissociated salt in the *o*- and *p*-positions. On any theory, the

results make it evident that the value obtained in an experiment in which the base is gradually added to the nitric acid represents a mere average, since the ionic concentration is progressively increased during the nitration. This must coincide with a decreasing rate of formation of the *m*-isomeride relative to that of the *p*-isomeride. (Attempts to define and apply standard conditions are being made.) Nevertheless we have found that the results obtained in the nitrations are reproducible and, although the numbers representing the proportions of *m*-isomeride formed have not the character of fundamental constants, some conclusions may be drawn from a consideration of these averages obtained in the case of related bases. It would, for example, appear most probable that the proportion of *m*-isomeride formed is partly related to the existence of constitutive factors that either hinder or assist the operation of electrostriction of the kations. In this connexion stereochemical conceptions are of primary importance (compare Flürscheim's steric factor, *s*, in the correlation of the strengths of bases with their constitutions), because it is clear that the anions or negative ends of polarised complexes can the more effectively modify the field of the positively charged nitrogen atom the closer they can approach it. Other things being equal, we should expect the degree of electrostriction of the kations to be influenced as follows :

(1) *The smaller the number of atoms directly attached to the central charged atom, the greater should be the degree of electrostriction.* The present authors have studied the nitration of a benzyldiethylsulphonium salt and will shortly submit an account of the work. The proportion of *m*-isomeride formed, although still noteworthy, is very much lower than in the nitration of benzyltrimethylammonium nitrate. We attribute the result partly to the fact that the central atom is surrounded by four atoms in the ammonium salt, but by only three in the sulphonium salt. Benzylmethylpiperidinium nitrate, $CH_2Ph{\cdot}NMe{:}[CH_2]_5{\}}NO_3$, gave more than 90% of the *m*-nitro-derivative on nitration, and the proportion of the *m*-nitro-isomeride formed in the nitration of benzylpyridinium perchlorate was estimated to be about 67%. The nitrogen atom is attached to four atoms in the first case, but to only three in the second. This explanation of the result is adequate, but we do not exclude the possibility that the charge may be distributed over the pyridine nucleus to some extent by induction and may thus be less effective on account of electron displacements towards it.

(2) *The greater the volume of the central charged atom the greater should be the degree of electrostriction.* In this case, the larger radius might be expected to hinder electrostriction, but this effect may be

ignored, since it also places the charge further away from the aromatic nucleus, and this in itself diminishes the intensity of the field. On the other hand, electrostriction should be facilitated in the larger atoms by the smaller electron density near the surface rendering such atoms *softer* and perhaps by the appearance of patches not covered by the surrounding atoms. Thus under comparable conditions we may anticipate diminishing *m*-substitution in ascending a group in the periodic system: *e.g.*, $CH_2Ph{\cdot}NR_3 > CH_2Ph{\cdot}PR_3 > CH_2Ph{\cdot}AsR_3 > CH_2Ph{\cdot}BiR_3$, and $CH_2Ph{\cdot}SR_2 > CH_2Ph{\cdot}SeR_2$.

(3) *The smaller the space occupied by the atoms or groups attached to the central charged atom, the greater should be the degree of electrostriction.* This consideration clearly applies to the case of hydrogen atoms, which have even been regarded as embedded in the electron shells (Thomson, Paneth). The nakedness of the proton is necessarily a most important factor favouring electrostriction in the salts of primary, secondary, and tertiary bases in diminishing degree. In other examples, the electron displacements and distances separating the atomic centres must also be taken into account.

(4) *The greater the mobility of the groups surrounding the central charged atom, the greater should be the degree of electrostriction.* We imagine that closer approach of the anions is possible when the surrounding groups can be pushed aside or when, as the result of their normal vibrations, there are phases in which the nucleus of the central atom is exposed. Herein, we suggest, lies the explanation of the benzylpiperidine case. In benzyldiethylamine, the ethyl groups are not fixed, but may be supposed to be capable of some movement over a limited area of the surface of a sphere. When the ends of the chains are joined together as in benzylpiperidine, this freedom of movement must be lessened and electrostriction would be hindered in consequence. It is proposed to test this hypothesis by instituting further comparisons between open-chain and cyclic bases. The highest proportion of the *m*-derivative should be formed in the nitration of *N*-alpharylquinuclidinium salts, since the molecular framework in this series should be especially rigid.

The course of the nitration of benzylpiperidine was unaffected by the addition of nitromethane or ethyl malonate to the reaction mixture, and the addition of nitrobenzene only lowered the proportion of *m*-isomeride formed to 58%. Evidently these weak bases do not form true ionised salts with nitric acid, and we suggest the following conception of the nature of the solutions. It is generally recognised that, in an acid HX, X has a more or less pronounced affinity for the negative charge and by electron displacement the nucleus of the proton is bared so that HX is polarised. In a base

Be (e = electron) of the type that might form a salt BeH}X, B has a more or less pronounced affinity for the positive charge, and this molecule also is polarised (or there may be a tendency to polarisation consummated by induction). In an acid, therefore, there are an intense local positive field and a diffuse negative field; in a base, the negative field is the more concentrated. The respective complexes thus contain *bound* ions (although the charges are not integral), and the ever-changing interplay of the forces between these is the interpretation we offer of the expression " loose additive complex " which might be applied to the cases considered. This hypothesis gives a very similar picture of the condition of salts and of additive complexes in solution. In both cases, moderately stable molecules containing a limited number of the components may exist for definite periods of time.

EXPERIMENTAL.

Method of Estimation of the Proportion of m-*Isomeride formed.*—In applying the method of Francis and Hill (*loc. cit.*) to the products of nitration of benzylpiperidine, we found that the presence of small quantities of unchanged benzylpiperidine did not affect the results and that the best procedure was to analyse directly the mixture of bases obtained. An important precaution was the avoidance of too large an excess of titanous chloride or of bromine. The nitro-compounds present were first estimated by reduction with titanous chloride and back-titration with ferric alum; reduction with a slight excess of titanous chloride was then effected in a fresh experiment, followed by bromination at 0° with the usual precautions. Within the limits of experimental error, the pure *o*-, *m*-, and *p*-nitrobenzyl-piperidines (Lellmann and Pekrun, *Annalen*, 1890, **259**, 40) (purity estimated by means of titanous chloride, 99—100%) required after reduction 2, 3, and 2 molecular proportions of bromine, respectively. The fact that stoicheiometric rather than empirical relations can be employed in the calculations was confirmed by the analysis of the following mixtures: *ortho*, 48·4% and *meta*, 51·6% (Found: *meta*, 48, 51·4%); *meta*, 48% and *para*, 52% (Found: *meta*, 44, 47, 52%); *meta*, 71% and *para*, 29% (Found: *meta*, 69, 72%).

Nitration of Benzylpiperidine.—The nitration (of 5 g.) was carried out as described by Ing and Robinson (J., 1926, 1664) and the bases were isolated by means of ether. The mononitration was almost theoretical (Found: *meta*, 66, 71, 72, 76, 77; mean, 72%). In subsequent experiments, the conditions of nitration were the same (3 g. of the base and 20 c.c. of nitric acid, d 1·50) and the yields were from 90—98%. When relatively large amounts of ammonium nitrate were added, stirring was rendered difficult by the separation

of solids from the solution when it was cooled to −15°. These may contain $NH_4NO_3,2HNO_3$, but also, in all probability, a similar complex derived from benzylpiperidinium nitrate, because the proportion of the base that was nitrated under the standard conditions was very much lower than in other cases. The results were : addition of ammonium nitrate (5 g.) (Found : nitration, 95%; *meta*, 57, 59, 59%); addition of ammonium nitrate (7 g.) (Found : nitration, 17·8%; *meta*, 54, 58%); addition of ammonium nitrate (8 g.) (Found : nitration, 24·5%; *meta*, 54, 56%).

Lithium, sodium, potassium, and rubidium nitrates form a series in which the solubility in nitric acid increases, lithium nitrate being very sparingly soluble and rubidium nitrate being freely soluble. Addition of rubidium nitrate (3 g.) gave a clear reaction mixture (Found : nitration, 98%; *meta*, 19, 23·4, 25%). From the results tabulated below, it was found that the equivalent amount of trimethylammonium nitrate should reduce the proportion of the *m*-isomeride formed to 24%.

Trimethylammonium nitrate was crystallised from alcohol until its m. p. was 152—153°. The effects of additions of this salt are shown in the following table :

$NHMe_3NO_3$ added (g.).	Nitration (%).	*Meta* (%).	Mean.
0·5	98·3	59, 62, 66, 71	64
1·0	99·3	50, 53	51·5
1·5	96·0	40, 40, 41	40
2·0	98·7	30, 31, 33	31·3
3·5	81·3	15, 16, 17	16
7·0	90·9	21, 21	21

The result with 7·0 g., indicating a rise in *m*-isomeride formation after a minimum value has been reached, will be further investigated when the conditions are more accurately defined. The percentage nitration of the base in this case was confirmed by reducing the product (1·62 g.) with zinc and dilute sulphuric acid, the resulting amines being then benzoylated and the unchanged benzylpiperidine isolated by distillation in steam. The picrate (0·18 g.) was obtained in canary-yellow crystals, m. p. 174—176°; mixed with the picrate of benzylpiperidine, m. p. 175—177°, it melted at 174°. We were thus able to isolate as picrate 67% of the unchanged benzylpiperidine which the titanous chloride estimation indicated to have been present in the nitration product.

Since the rate of predominating *m*-substitution in a mono-substituted benzene derivative is always lower than that of predominating *op*-substitution (Holleman), it seemed possible that the degradation of the reagent might result in a diminution of the proportion of the *m*-isomeride formed. The gradient of the curve representing the relation between reaction velocity and chemical

activity of the reagent should, in other words, be steeper in the case of the formation of the *m*-isomeride. This consideration might have a bearing on the effect of addition of salts to the nitric acid, and we therefore tried another method of degradation, namely, the removal of nitrous acid. Urea (1·0 g.) was added to nitric acid (20 c.c.; *d* 1·51), which was then cooled in a freezing mixture and thereafter allowed to warm to the ordinary temperature (the density became 1·52); after cooling again, the mixture was employed in a nitration under the standard conditions (Found: nitration, 99%; *meta*, 45, 45%). Lead peroxide was added to nitric acid (*d* 1·53), mixed with a little acid (*d* 1·54) prepared by distillation of a mixture of nitric acid (*d* 1·51) and phosphoric anhydride; after filtration the acid had *d* 1·51 and was free from lead. The nitration was carried out with this specimen in the presence of a small amount of lead peroxide (Found: nitration, 94%; *meta*, 65, 69, 73%). Another specimen of nitric acid (*d* 1·5) was prepared by the addition of concentrated aqueous hydrogen peroxide to nitric acid (*d* 1·54), and this was employed in the nitration (Found: nitration, 98%; *meta*, 71%).

When the standard nitration conditions were modified by reduction of the volume of nitric acid to 10 c.c., a small diminution in the proportion of *m*-isomeride formed was observed (Found: nitration, 95%; *meta*, 61, 62, 64%), but when the volume of nitric acid employed for the nitration of 3 g. of the base was trebled (60 c.c.) some dinitration occurred.

The following results were obtained under the standard conditions modified as stated: Addition of nitrobenzene (5 g.) (Found: nitration, 98%; *meta*, 57, 59%); addition of nitromethane (2·5 g.) (Found: nitration, 99%; *meta*, 70, 73, 73%); addition of ethyl malonate (6·5 g.) (Found: nitration, 97%; *meta*, 69, 69%).

Benzyldiethylamine was nitrated under the conditions used for benzylpiperidine (Found: nitration, 98%; *meta*, 48, 50, 51%).

Nitration of Benzylmethylpiperidinium Nitrate.—*Benzylmethylpiperidinium iodide*, prepared from benzylpiperidine and methyl iodide, crystallises from ethyl alcohol in colourless needles, m. p. 147° (Found: I, 40·0. $C_{13}H_{20}NI$ requires I, 40·1%). It is readily soluble in water and in hot alcohol.

This salt was converted into the *nitrate* by exact decomposition with silver nitrate, and the aqueous solution was evaporated to a syrup and then in a vacuum over sulphuric acid for several months. The friable solid was extremely hygroscopic, liquefying in the air in a few seconds; an estimation by means of nitron, combined with a titration showing the amount of free nitric acid present, indicated that the material contained 99—100% of the quaternary nitrate.

The salt (20 g.) was added to nitric acid (80 c.c.; *d* 1·5) at 0° during 15 minutes, and the solution kept at this temperature for 2 hours and at room temperature for 2 hours more. The liquid was then diluted and distilled under diminished pressure, and this process was repeated so as to remove most of the nitric acid. The residue was neutralised with ammonia, and the picrate precipitated by stirring for 1 hour with an excess of picric acid. The mixture of picrate and picric acid was collected, washed with aqueous picric acid, and mechanically shaken with ether and dilute hydrochloric acid until no solid remained. The acid aqueous solution was concentrated under diminished pressure, again extracted with ether, and then neutralised with ammonia and concentrated to about 100 c.c. The iodide was then precipitated by the addition of a large excess of sodium iodide (yield, 94%). The crude nitration product (10 g.) was fractionally crystallised from methyl alcohol; 9·7 g. of the pure *m*-isomeride were obtained (Found: I, 35·0%), and the colour reactions of the last mother-liquor showed that it still contained the *m*-isomeride in preponderating amount, a little of the *p*-isomeride, and a yellow impurity.

The three nitrobenzylmethylpiperidinium iodides were prepared from the nitrobenzylpiperidines and methyl iodide and dried at 100° for analysis. o-*Nitrobenzylmethylpiperidinium iodide* crystallises from methyl alcohol in intensely yellow prisms, m. p. 183—184° (Found: I, 34·9. $C_{13}H_{19}O_2N_2I$ requires I, 35·1%). This salt develops a brownish-yellow colour in boiling methyl-alcoholic potassium hydroxide, and on the addition of a methyl-alcoholic solution to acetone and solid potassium hydroxide a bright brownish-red solution is obtained.

m-*Nitrobenzylmethylpiperidinium iodide* crystallises from methyl or ethyl alcohol in very pale yellow needles which darken at 198° and melt at 204° (Found: I, 35·1%). It gives no coloration in boiling methyl-alcoholic potassium hydroxide, but when a methyl-alcoholic solution is added to acetone and solid potassium hydroxide an intense and characteristic violet colour is developed.

p-*Nitrobenzylmethylpiperidinium iodide* crystallises from water or methyl alcohol in large, well-developed, yellow prisms, and from ethyl alcohol in pale yellow needles, m. p. 188° (decomp.) (Found: I, 34·9%). This salt develops a reddish-brown coloration in boiling methyl-alcoholic potassium hydroxide, and a dull mauve-red one when a methyl-alcoholic solution is added to acetone and solid potassium hydroxide.

These salts exhibit colour reactions under other conditions, but those recorded above were selected, after numerous trials, for the purpose of assisting in the identification of specimens. It will be

observed that under one set of conditions the *m*-isomeride gives no reaction whereas the *o*- and *p*-isomerides develop colorations; under the other set of conditions the *m*-isomeride gives the most characteristic reaction.

Nitration of Benzylpyridinium Perchlorate.—Aqueous perchloric acid was added to a solution of benzylpyridinium chloride; the precipitated oil crystallised in contact with ice-water. The dry salt (20 g.) was added during 45 minutes to nitric acid (100 c.c.; *d* 1·5) at 0°; the mixture was kept at this temperature for 1 hour and then allowed to warm to the temperature of the room during 1·5 hours. The solution was diluted, the greater part of the nitric acid distilled under diminished pressure, an excess of perchloric acid (*d* 1·12) added, and the mixture kept in the ice-chest for 24 hours; the precipitated perchlorates were then collected, washed, and dried (A) (20·5 g.) (Found: C, 45·8; H, 3·6. $C_{12}H_{11}O_6N_2Cl$ requires C, 45·9; H, 3·5%). In another experiment, the nitric acid was not removed and the crystallisation of the perchlorates was carried out fractionally, crops of approximately 12 g., 5 g., and 3 g. being obtained. On recrystallisation, the first fraction gave pure *m*-nitrobenzylpyridinium perchlorate, but the separation could not be carried out in a quantitative manner. Oxidation of the crude nitration product with potassium permanganate gave *m*- and *p*-nitrobenzoic acids, which were separated and identified; the yields, however, were not satisfactory. It was found possible to apply Francis and Hill's bromination method to this case, because the nitrobenzylpyridinium perchlorates may be quantitatively reduced to aminobenzylpyridinium chlorides by means of titanous chloride. This is not effected, however, under the ordinary conditions and the following experiment indicates the modifications required. A solution of *p*-nitrobenzylpyridinium perchlorate (0·1000 g.) in 50% sulphuric acid (25 c.c.) and water (150 c.c.) was boiled with titanous chloride for 20 minutes with the usual precautions, care being taken to avoid undue concentration (Found: titanous chloride solution used, 37·2 c.c. Calc. for complete reduction, 37·3 c.c.). Applying this method of reduction to the product (A), followed by bromination in the usual manner, we found *meta*, 64, 69, 69%. A mixture of *m*-nitrobenzylpyridinium perchlorate (70%) and *p*-nitrobenzylpyridinium perchlorate (30%) was similarly analysed (Found: *meta*, 69, 71%).

The isomeric nitrobenzylpyridinium perchlorates were prepared by addition of perchloric acid to solutions of the corresponding chlorides or bromides.

o-*Nitrobenzylpyridinium perchlorate* crystallises from alcohol in colourless, elongated, rhombic prisms, m. p. 155—156° (Found: C,

46·1; H, 3·5. $C_{12}H_{11}O_6N_2Cl$ requires C, 45·9; H, 3·5%). The action of boiling aqueous sodium hydroxide on this salt causes a decomposition, one of the products of which is *o*-nitrotoluene.

m-*Nitrobenzylpyridinium perchlorate* crystallises from alcohol in colourless, prismatic needles, m. p. 176—177° (Found: C, 46·0; H, 3·6%).

p-*Nitrobenzylpyridinium perchlorate* crystallises from alcohol in colourless, elongated laminæ, m. p. 181—182° (Found: C, 46·0; H, 3·6%). The long, flat plates have jagged edges and well-formed pointed or square-cut ends and exhibit a strong twinning tendency. On boiling with sodium hydroxide solution, *p*-nitrotoluene is produced.

1-β-*Phenylethylpiperidine.*—The preparation of 1-*iso*butoxymethylpiperidine (McLeod and G. M. Robinson, J., 1921, **119**, 1474) is conveniently carried out on a moderately large scale. A mixture of piperidine (400 g.) and *iso*butyl alcohol (400 g.) was added to 40% aqueous formaldehyde solution (400 g.) with cooling in running water; the mixture was saturated with potassium carbonate and kept over-night and the oil was then dried with fresh potassium carbonate. On distillation, 665 g., b. p. 200—210°, were obtained (yield, 83%). The considerations dictating the use of *iso*butyl alcohol are that the higher alcohols give the better yields, and that some decomposition occurs in the distillation of 1-*n*-butoxymethylpiperidine under ordinary pressure. *iso*Butoxymethylpiperidine (120 g.) was slowly added to an ethereal solution of magnesium benzyl chloride (from 100 g. of benzyl chloride, 20 g. of magnesium, and about 1500 c.c. of ether), a violent reaction ensuing after each addition. Water was then cautiously introduced with shaking until a clear ethereal layer could be decanted from the magnesia sludge; the latter was washed with fresh ether. The base was extracted from the ethereal solution by successive small volumes of dilute hydrochloric acid, and any unchanged *iso*butoxymethylpiperidine decomposed by heating the acid solutions for 15 minutes on the steam-bath. The base was then set free by means of sodium hydroxide, separated, dried with sodium hydroxide, and distilled. 105 G., b. p. 162°/35 mm., of a colourless oil were obtained (yield, 80% calculated on the *iso*butoxymethylpiperidine) (Found: equiv., 189·3. Calc., 189·2). The b. p./760 mm. was 262—264° with some decomposition. The *picrate* crystallised from alcohol in perfectly straight, canary-yellow needles, m. p. 144—145° (Found: N, 13·4. $C_{19}H_{22}O_6N_4$ requires N, 13·4%). The length of the individual crystals seems to be limited only by the shape of the container and the volume of the solution; those which we obtained were about 8—10 cm. long.

On nitrating the base under the conditions used for benzylpiperidine, and assuming the stoicheiometric relation for the bromination of the *m*- and *p*-amino-derivatives, we found: nitration, 98%; *meta*, 20, 22·7, 24%.

1 - γ - *Phenylpropylpiperidine*, $CH_2Ph{\cdot}CH_2{\cdot}CH_2{\cdot}N{:}[CH_2]_5$.—The method described in the last section was applied, the initial materials being phenylethyl bromide (98 g.), magnesium (12·5 g.), and *iso*-butoxymethylpiperidine (85 g.). 59 G. of a colourless oil, b. p. 150°/15 mm., were obtained (yield, 58%) (Found: equiv., 202. Calc., 203). This base has b. p. 272—274°/760 mm. with decomposition. The *picrate* crystallises from alcohol in bright yellow tablets, m. p. 99—100° with slight previous softening (Found: N, 13·0. $C_{20}H_{24}O_6N_4$ requires N, 13·0%).

In this case, nitration with nitric acid (*d* 1·5) causing some dinitration, the standard conditions were employed with nitric acid having *d* 1·465 (Found: nitration, 99%; *meta*, 5, 6, 8%).

We desire to thank the Department of Scientific and Industrial Research for grants which have enabled one of us to take part in the investigation.

THE UNIVERSITY, MANCHESTER. [*Received, September 2nd*, 1972.]