Papers and Originals

Obstetric Complications and School Performance

D. J. P. BARKER,*† M.B., B.SC., PH.D.; J. H. EDWARDS,* M.R.C.P.

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Little is known about the mental development of children who are exposed to obstetric complications and escape the immediate hazards of perinatal death or severe brain injury. This lack of knowledge results from the practical difficulties involved in collecting the obstetric histories of a large number of infants and relating them to school performance, or to some other index of intellectual development, several years later. During the past 16 years obstetric records have been compiled for all births within the City of Birmingham, and these now permit an analysis of the relation between obstetric history and performance in the verbal reasoning tests which form part of the selective examination for 11-year-old schoolchildren.

Since performance in verbal reasoning tests is determined by genetic endowment, prenatal environment, and the physical and social environment after birth, data relating small differences in performance to obstetric events can be interpreted only against a control population matched for similar hereditary, prenatal, and postnatal determinants. Therefore unless the differences are large sibs provide the only possible controls.

In this paper the verbal reasoning scores of children exposed to obstetric complications are compared with those of their sibs and of the population of 50,000 children to which they belong.

Method

The population comprised all children who were born in Birmingham during 1950–4 and subsequently took the "eleven-plus" examination there. It did not include children who left the city or died before the age of 11 years, or who did not take the examination because they were in private schools, special schools for the handicapped, or, though in ordinary schools, had been assessed as "borderline subnormal."

Eleven-plus candidates have to take two verbal reasoning tests. These are a form of group intelligence test, and the means of the two scores obtained are transformed and adjusted so that the scores of candidates born in different months have a mean of 100 and a standard deviation of 15. The present investigation is based on analysis of these age-adjusted verbal reasoning (V.R.) scores.

Obstetric data which have been recorded on punch cards for all births in Birmingham since 1950 (Charles, 1951) were converted into a constant format and transferred to magnetic tape. The eleven-plus results of all children who took the examination in Birmingham during 1961–5 were made available, and these also were transferred to magnetic tape. The records on the two data tapes were sorted into sequence depending on names and dates of birth, and the data were merged to form a third tape. An eleven-plus record was linked with a birth record if the first name, surname, and date of birth were identical when expressed in the Hogben numeric code (Hogben, Johnstone, and Cross, 1948). As a result of this procedure birth and examination records of 50,046 children were linked.

Children born during the last quarter of 1954 were too young to have taken the eleven-plus during 1965, and the population of 50,046 children was therefore restricted to those born from 1 January 1950 to 1 September 1954. Subsequent comparison of surnames and addresses on the combined birth and eleven-plus records led to identification of 12,959 sibs from 6,129 fraternities within the population.

* Department of Social Medicine, Medical School, The University, Birmingham 15.
† Present address: Department of Medicine, Medical School, The University, Birmingham 15.

Results

Plurality

Table I shows that the mean V.R. scores of twins and triplets are 4.8 and 13.3 units below the mean score of single-born children. This confirms the observations of Mehrotra and Maxwell (1949) and of Sandon (1957). As multiple pregnancies impose a peculiar prenatal environment, and the survivors have an unusual upbringing, further analysis in this paper is restricted to the 48,795 single-born children.

TABLE I.—*Mean V.R. Scores According to Plurality*

Single-born	Twins	Triplets
100·2 (48,795)	95·4 (1,233)	86·9 (18)

Numbers of children are given in parentheses.

Birth Rank

The number of previous livebirths and stillbirths was recorded for all except 50 of the children. Within the population the mean V.R. score falls with increasing birth rank, from 102.8 in birth rank 1 to 89.3 in birth ranks 10 or more (Table II). Comparison of mean scores of sibs in each birth rank with those of sibs in the preceding rank (Table III) shows that within fraternities the V.R. score falls with increasing birth order, with an average fall of 1.0 for each unit increase in birth order.

Duration of Gestation

The gestation period, calculated to the nearest week from the first day of the last menstrual period, was recorded for

TABLE II.—*Mean V.R. Scores According to Birth Rank*

Birth Rank									
1	2	3	4	5	6	7	8	9	10+
102·8 (17,065)	101·6 (13,803)	98·8 (8,122)	96·6 (4,378)	93·8 (2,296)	93·1 (1,303)	92·4 (748)	90·4 (439)	89·8 (270)	89·3 (321)

TABLE III.—*Mean V.R. Scores in Sib Pairs According to Birth Rank*

	Birth Rank									Total
	1	2	3	4	5	6	7	8	9	
Children in each birth rank (a)	—	100·2	98·1	95·7	93·2	91·5	93·1	91·0	90·3	97·7
Children in preceding birth rank (b)	—	101·7	99·1	96·0	94·1	92·4	92·0	91·4	88·8	98·7
Difference (a)–(b)	—	−1·5 (2,208)	−1·0 (1,293)	−0·3 (711)	−0·9 (413)	−0·9 (211)	+1·1 (126)	−0·4 (74)	+1·5 (49)	−1·0 (5,085)

41,452 children (85%). The mean V.R. scores of children born at term (38 to 41 weeks) are above average; but the children born after either longer or shorter gestations have mean scores below the average (Table IV). Table V shows the mean scores among pairs of sibs in consecutive birth ranks, of whom one member was born at term (term sib) and the other was born either before term (28 to 37 weeks) or after term (more than 41 weeks). Because of the relation between V.R. score and birth order within fraternities (Table III) the results are subdivided according to whether the term sib is the earlier- or later-born member of the pair. In the sib pairs which include one child born before term both sibs were born after pregnancies uncomplicated by antenatal disease and after labours of spontaneous onset. In the pairs in which one child was born after term both sibs were likewise born after uncomplicated pregnancies but sibs born after induced labours were not excluded.

TABLE IV.—*Mean V.R. Scores According to Duration of Gestation in Fortnights*

28–	30–	32–	34–	36–	38–	40–	42–	44+
80·1 (15)	95·8 (89)	93·5 (186)	96·3 (635)	97·4 (2,170)	100·3 (10,169)	100·7 (22,410)	99·4 (5,119)	97·1 (659)

In Table V the mean scores of affected children—that is, of sibs born before and after term—exceed those of their term sibs in the subsequent birth rank by 1.2 and 0.7 respectively. This may be attributed to the higher birth order of the term sibs. But when affected children are compared with term sibs in the preceding birth rank their mean scores are 2.5 and 1.8 lower. These differences exceed the average fall of 1.0 for each unit increase in birth order and, together with the lower mean scores in the population (Table IV), they suggest that shortened and prolonged gestation periods are associated with impaired performance on V.R. tests. There is, however, no marked difference in the percentage distribution of scores of children born before, at, or after term (Table VI).

TABLE V.—*Mean V.R. Scores in Sib Pairs of Whom One Member Was Born at Term (38 to 41 Weeks of Gestation) and the Other Either Before Term (28 to 37 Weeks) or After Term (More Than 41 Weeks)*

	Born Before Term	Born After Term
Affected children (a)	97·6	96·7
Sibs in subsequent birth rank born at term (b)	96·4	96·0
Difference (a)–(b)	+1·2 (120)	+0·7 (229)
Affected children (c)	95·0	96·9
Sibs in preceding birth rank born at term (d)	97·5	98·7
Difference (c)–(d)	−2·5 (163)	−1·8 (312)

Numbers of sib pairs are given in parentheses.

Antenatal Diseases

The presence or absence of antenatal disease was recorded for 45,650 children (94%), and Table VII shows the mean V.R. scores of children born after pregnancies complicated by toxaemia, non-toxic antepartum haemorrhage, or anaemia.

TABLE VII.—*Mean V.R. Scores According to Antenatal Disease*

Toxaemia	Non-toxic A.P.H.	Anaemia
101·9 (3,321)	97·9 (641)	97·4 (1,338)

In the compilation of the birth records the coding "toxaemia" was applied to all cases of hypertension or albuminuria during pregnancy. The mean V.R. score of children born after toxaemic pregnancies is above the population mean. But the incidence of toxaemia in birth rank 1 is twice that in the other ranks; and children in birth rank 1 have the highest mean V.R. scores (Table II). When children from toxaemic pregnancies are distributed according to birth rank, their mean V.R. score is consistently greater than the mean for all children in the same birth rank (Table VIII). Since, however, less intelligent mothers tend to neglect regular antenatal examination, there is probably a correlation between maternal intelligence and the diagnosis of toxaemia; and the intellectual performance of mothers and their children is known to be correlated.

TABLE VIII.—*Mean V.R. Scores of Children Affected by Toxaemia, According to Birth Rank*

	1	2	3	4	5	6+
Children affected by toxaemia	103·7 (1,855)	101·9 (725)	100·1 (325)	96·7 (186)	94·7 (93)	92·2 (136)
Whole population of children	102·8	101·6	98·8	96·6	93·8	91·9

Table IX, constructed in the same way as Table V, shows that the mean V.R. score of children from toxaemic pregnancies is only 0.5 above that of their sibs in the subsequent birth rank and is 2.0 below that of sibs in the preceding rank. This suggests that toxaemia is associated with an impaired V.R. test performance. Table X shows that in sib pairs, of which both members were born at term (38 to 41 weeks of gestation), children from toxaemic pregnancies were at a great disadvantage compared with their normal sibs. The association between toxaemia and impaired V.R. performance does not therefore seem to be secondary to the known association between toxaemia and a shortened period of gestation. In accord with their higher mean score the distribution of scores of children from toxaemic pregnancies differs slightly from that of the whole population of children (Table XI).

The mean V.R. score of children affected by non-toxic antepartum haemorrhage is 97.9 (Table VII). This may be compared with a mean score of 99.5 for children with the same

TABLE VI.—*Percentage Distribution of V.R. Scores According to Duration of Gestation*

Duration of Gestation	V.R. Score								No. of Children	Mean Score
	Below 70	70–	80–	90–	100–	110–	120–	130+		
28–37 weeks	3·5	8·4	18·4	26·4	25·1	13·0	4·5	0·9	3,095	96·8
38–41 ,,	1·6	5·8	14·7	25·1	25·7	17·6	7·5	2·0	32,579	100·6
42+ ,,	2·1	6·8	16·2	26·2	24·7	16·5	6·1	1·4	5,778	99·1

birth-rank distribution. However, the scores of affected children are not lower than those of their unaffected sibs (Table IX). "Non-toxic antepartum haemorrhage" is a description that was applied to antepartum bleeding which resulted from many causes but was not associated with toxaemia; and even some cases of threatened abortion were classified in this way. From the results in Tables VII and IX one can draw only the general conclusion that disturbances of the placenta which result in bleeding during pregnancy, in the absence of toxaemia, do not usually influence subsequent V.R. performance.

TABLE IX.—*Mean V.R. Scores in Sib Pairs According to Antenatal Disease*

	Toxaemia	Non-toxic A.P.H.	Anaemia
Affected children (a)	100·3	99·8	97·7
Unaffected sibs in subsequent birth rank (b)	99·8	98·1	95·3
Difference (a)–(b)	+0·5 (180)	+1·7 (44)	+2·4 (92)
Affected children (c)	100·8	95·1	97·9
Unaffected sibs in preceding birth rank (d)	102·8	94·5	98·7
Difference (c)–(d)	−2·0 (162)	+0·6 (66)	−0·8 (191)

TABLE X.—*Mean V.R. Scores in Sib Pairs Both of Whom Were Born at 38–41 Weeks of Gestation and One of Whom Was Affected by Toxaemia or by Non-haemolytic Jaundice*

	Toxaemia	Non-haemolytic Jaundice
Affected children (a)	100·8	102·0
Unaffected sibs in subsequent birth rank (b)	101·5	101·6
Difference (a)–(b)	−0·7 (87)	+0·4 (36)
Affected children (c)	101·0	104·7
Unaffected sibs in preceding birth rank (d)	103·2	105·0
Difference (c)–(d)	−2·2 (100)	−0·3 (42)

Presentation at Onset of Labour

Table XII shows the mean V.R. scores of the 45,291 children (93%) whose type of presentation was recorded. Although the mean score of all children whose presentation was occipito-posterior is 100.4, the mean score of affected sibs is only 0.1 above that of unaffected sibs in the subsequent birth rank and is 2.5 below that of unaffected sibs in the preceding rank (Table XIII). This is evidence of an association between occipito-posterior presentation and an impaired V.R. performance. The percentage distribution of the affected children is similar to that of the whole population of children (Table XI).

In Tables XII and XIII there is no evidence of any marked association between other forms of presentation and V.R. performance, though the numbers of brow presentations and presentations caused by a transverse lie were too small to permit comparisons within sib pairs.

TABLE XII.—*Mean V.R. Scores According to Type of Presentation at Onset of Labour*

Normal Vertex	Occipito-posterior	Brow	Face	Breech	Caused by Transverse Lie
99·8 (41,929)	100·4 (2,232)	106·9 (35)	98·5 (116)	99·2 (913)	99·5 (66)

TABLE XIII.—*Mean V.R. Scores in Sib Pairs According to Type of Presentation at Onset of Labour*

	Occipito-posterior	Face	Breech
Affected children (a)	97·8	100·2	102·3
Unaffected sibs in subsequent birth rank (b)	97·7	89·4	99·1
Difference (a)–(b)	+0·1 (188)	+10·8 (9)	+3·2 (56)
Affected children (c)	96·9	92·1	95·1
Unaffected sibs in preceding birth rank (d)	99·4	93·2	97·6
Difference (c)–(d)	−2·5 (229)	−1·1 (12)	−2·5 (96)

Type of Labour

In the records of 46,236 (95%) of the children the type of labour was classified to show whether the onset was spontaneous or induced, and whether delivery was natural, instrumental, or by caesarean section.

The mean V.R. score of children born by instrumental delivery is 103.5 (±0.4) (Table XIV). This may be compared with a mean score of 102.0 for children with the same birth-rank distribution. The mean score of 103.0 (±0.5) for children born by caesarean section may be similarly compared with a mean score of 101.2. Within fraternities the mean score of children born by instrumental delivery is higher than that of sibs in both the subsequent and preceding birth ranks (Table XV). Though small numbers make interpretation difficult, Table XV also suggests that the V.R. performance of children born by caesarean section is better than that of their sibs.

TABLE XIV.—*Mean V.R. Scores According to Method of Delivery*

Natural	Instrumental	Caesarean Section	"Other"
99·6 (43,452)	103·5 (1,661)	103·0 (1,016)	101·7 (107)

TABLE XV.—*Mean V.R. Scores in Sib Pairs According to Method of Delivery*

	Instrumental	Caesarean Section
Affected children (a)	102·3	106·6
Unaffected sibs in subsequent birth rank (b)	100·0	96·5
Difference (a)–(b)	+2·3 (145)	+10·1 (9)
Affected children (c)	97·1	95·9
Unaffected sibs in preceding birth rank (d)	95·5	93·2
Difference (c)–(d)	+1·6 (34)	+2·7 (13)

TABLE XI.—*Percentage Distribution of V.R. Scores of Children Affected by Toxaemia, Occipito-posterior Presentation, or Delivery in an Ambulance*

	V.R. Score								No. of Children	Mean Score
	Below 70	70–	80–	90–	100–	110–	120–	130+		
Toxaemia	1·6	4·7	12·7	24·7	26·5	18·8	8·3	2·6	3,321	101·9
Occipito-posterior presentation	1·6	5·5	14·9	25·6	25·7	18·3	6·6	1·8	2,232	100·4
Delivery in an ambulance	5·2	9·2	20·4	31·2	18·8	10·0	4·8	0·4	250	94·3
Whole population of children	1·8	6·3	15·3	25·0	25·3	17·2	7·3	2·0	48,795	100·2

In the classification of type of labour the category "other" denoted labours and deliveries which were regarded as unusual. This category was not strictly defined, but its most frequent use was for labours which ended in breech extractions. The mean V.R. score of children born after "other" types of labour is 101.7 (Table XIV) and therefore exceeds that of the whole population. Numbers were too small to permit comparisons within sib pairs.

Precipitate Labour

In the compilation of the birth data a simple classification was used to denote the duration of labour. The time recorded was that from the beginning of the first stage until the completion of the second. For children born after labours completed in two hours or less (a precipitate labour) the mean V.R. score is 97.7 (Table XVI). This may be compared with a mean of 99.0 for children with the same birth-rank distribution. Although the mean score of affected children is 2.5 above that of sibs in the subsequent birth rank and only 0.5 below that in the preceding rank (Table XVII), these differences seem too small to justify the conclusion that precipitate labour and V.R. performance are associated.

TABLE XVI.—*Mean V.R. Scores of Children Born After Precipitate Labour, or Delivered in Ambulances or in the Absence of a Qualified Attendant*

Born After Precipitate Labour	Delivered in Ambulance	Delivered in Absence of Qualified Attendant
97·7 (2,985)	94·3 (250)	95·3 (981)

TABLE XVII.—*Mean V.R. Scores in Sib Pairs One of Whom Was Born After a Precipitate Labour, or Delivered in an Ambulance or in the Absence of a Qualified Attendant*

	Born After Precipitate Labour	Delivered in Ambulance	Delivered in Absence of Qualified Attendant
Affected children (a)	96·9	94·8	93·1
Unaffected sibs in subsequent birth rank (b)	94·4	93·2	91·8
Difference (a)-(b)	+2·5 (200)	+1·6 (29)	+1·3 (107)
Affected children (c)	98·4	93·7	97·3
Unaffected sibs in preceding birth rank (d)	98·9	96·9	97·4
Difference (c)-(d)	−0·5 (589)	−3·2 (90)	−0·1 (200)

Birth Attendant

Observations of the type of attendant present at birth—for example, hospital midwife or general practitioner—included cases where birth had occurred in an ambulance or before the arrival of a qualified attendant. The mean V.R. scores of the affected children are low (Table XVI). This may be partly or wholly the result of the known associations of inadequately supervised delivery with both precipitate labour and with poor social circumstances. The mean score of children born in ambulances is 1.6 above that of unaffected sibs in the subsequent birth rank, and 3.2 below that of sibs in the preceding birth rank (Table XVII). This is evidence of some direct association between impaired V.R. performance and birth in an ambulance. There is no evidence of a similar association with birth in the absence of a qualified attendant (Table XVII). The percentage distribution of children born in ambulances (Table XI) shows that a considerable excess of affected children (66%) have scores below the population mean (100.2).

Condition after Birth

This was recorded for 46,439 (95%) of the children. The mean V.R. score of children who had non-haemolytic jaundice is 100.2 (Table XVIII). Levels of serum bilirubin were not recorded. Table XIX shows that the mean scores of affected children are below those of sibs in the subsequent as well as the preceding birth rank; and this suggests that neonatal non-haemolytic jaundice is associated with an impaired V.R. performance. However, when comparison is restricted to sibs born at term (Table X) the association is no longer present, which suggests that it is secondary to the increased incidence of non-haemolytic jaundice among children born before term.

TABLE XVIII.—*Mean V.R. Scores According to Condition After Birth*

Non-haemolytic Jaundice	Birth Injury and/or Asphyxia
100·2 (903)	100·8 (909)

TABLE XIX.—*Mean V.R. Scores in Sib Pairs According to Condition After Birth*

	Non-haemolytic Jaundice	Birth Injury and/or Asphyxia
Affected children (a)	99·6	99·8
Unaffected sibs in subsequent birth rank (b)	100·0	95·1
Difference (a)-(b)	−0·4 (68)	+4·7 (56)
Affected children (c)	99·9	99·1
Unaffected sibs in preceding birth rank (d)	100·7	101·9
Difference (c)-(d)	−0·8 (117)	−2·8 (74)

A single coding was used to denote children who showed signs of trauma or asphyxia at birth. Therefore children who, for example, had cephalhaematomata, or were unusually cyanosed after birth, were coded in the same way. Such data permit only general conclusions. Nevertheless Tables XVIII and XIX provide no evidence that "birth injury and/or asphyxia" is related to academic performance in children within the normal range of intelligence.

Discussion

The results of this inquiry are based on an analysis of eleven-plus performance in a population of Birmingham-born children. This population did not include children who were of very low intelligence, who were in special schools for the physically handicapped, or who died before the age of 11 years. Children who had moved out of the city were also excluded, and the population was therefore unrepresentative of all eleven-plus candidates. However, it is difficult to see how this can affect the conclusions, which are mainly dependent on comparisons within fraternities.

Only five of the obstetric complications studied seemed to be associated with impaired V.R. performance: a short gestation period, a prolonged gestation period, toxaemia, occipito-posterior presentation, and delivery in an ambulance. Children born at term (38 to 41 weeks of gestation) had a higher mean V.R. score than children born after shorter or more prolonged gestation periods (Table IV); and comparison between sibs (Table V) suggested that in some cases impaired performance might be a direct consequence of birth before or after term. The results did not confirm those of Dale (1966), who, from a study of 179 children, concluded that "it is possible that a higher intelligence could be obtained by delivery before 40 weeks of gestation, provided the mother is obstetrically normal."

Children from toxaemic pregnancies were found to be at a great disadvantage compared with their unaffected sibs when they were born at term. The data did not permit further elucidation of this, but one interpretation of the finding is that induction of labour in cases of toxaemia may curtail a period during which the foetus sustains cerebral damage.

It it is accepted that the five obstetric complications—birth before and after term, toxaemia, occipito-posterior presentation,

and delivery in an ambulance—do result in impaired academic performance among children at ordinary schools, it seems unlikely that they exert more than a small influence on the intellectual development of children exposed to them. The distributions of scores of affected children were unimodal (Tables VI and XI) and therefore provided no evidence of a substantial group of children whose development was greatly impaired; and there were only small differences in the mean scores of affected and unaffected sibs.

A previous analysis of the relation between obstetric complications and subnormal intelligence (an I.Q. below 75), based on the same obstetric data as the present analysis, revealed an association between educational subnormality and both precipitate labour and delivery in the absence of a qualified attendant (Barker, 1966). But neither of these complications seems to be associated with impaired performance within the normal range of intelligence.

The mean V.R. scores of children delivered instrumentally or by caesarean section were higher than those of the population and of their unaffected sibs. It seems reasonable to suppose that a child born by caesarean section may avoid cerebral damage sustained in a normal delivery; but it is difficult to explain the association between instrumental delivery and raised V.R. scores. The data are, however, too complex to justify the conclusion that instrumental delivery will improve school performance.

The finding that the mean V.R. score in the population declines with increasing birth rank (Table II) confirms numerous previous observations of the negative correlation between fraternity size and measured intelligence. But this inquiry has also shown that within fraternities there is an average fall of 1.0 in V.R. score with each unit increase in birth order.

Summary

Birth records of 50,000 children were linked with records of school performance at the age of 11. Twins and triplets showed marked impairment, and were excluded from this study. The verbal reasoning (V.R.) scores of single-born children exposed to obstetric complications were compared with those of the population and of their sibs. The results suggested that impaired performance was associated with only five of the obstetric complications studied: a short gestation period, a prolonged gestation period, toxaemia, occipito-posterior presentation, and delivery in an ambulance. In no case was the impairment very marked. Within fraternities there was a fall in average V.R. score with increasing birth rank.

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Paraproteins, Benign or Malignant?

J. R. HOBBS,* M.D., M.R.C.P., M.C.PATH.

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Paraproteins are those serum proteins which on electrophoresis are found to run as an abnormal narrow band between the positions occupied by the inter-α and post-γ protein fractions. Once it is confirmed that the paraprotein contains a heavy chain or a light chain, or both, of one class only—that is, a monoclonal immunoglobulin or fragment thereof—it may be assumed that it has come from a single clone of cells within the reticuloendothelial system. The question then remains, will this "monoclone" behave in a malignant fashion—invading bone (myelomatosis), lymphoid tissue (lymphomata), or the blood stream (leukaemia)—or will it, like a benign tumour, strike a balance with its neighbouring tissues and cause no harm to the patient?

Though much work (well reviewed by Hällén, 1966) has dealt with both malignant and benign conditions, less is known about the intermediate diseases owing to inadequate investigation during life or at necropsy. The present study includes 304 patients followed up to the time when a diagnosis of malignant disease was established or for at least three years. Prospective examination of fresh serum and urine from every patient has shown findings of prognostic value.

Investigation of Paraproteins

Serum

Serum was separated at 37° C. to avoid missing cryoproteins and then electrophoresed on cellulose acetate. False M bands due to fibrinogen or old or uraemic serum were excluded (Hobbs, 1966a).

The level of M protein was estimated as a percentage of the total uptake of amidoschwarz 10 *B* under standard conditions (Hobbs, 1965), great care being taken always to load the strip within a linear range, often set by the narrow bands of paraprotein. Strips were often run with decreasing applications until the percentage became constant. Usually no attempt was made to simulate peaks or subtract any underlying proteins—vertical cuts were made down the peaks. In this way reproducibility of $\pm 2\%$ was achieved. From the total protein by a biuret method (suitably diluted for high values) using Armour bovine albumin standard the percentage of paraprotein was converted to g./100 ml. in the case of γG, γA, and γD (where the dye-binding and biuret colour compared to albumin is reliable to within 5% overall). As the biuret method underestimates γM-paraproteins by 12%, the specific gravity gradient tube of Lowry and Hunter (1945) was used for determining the total protein in such cases. By the above technique pure isolated paraproteins calibrated by ultraviolet absorption could be added to normal serum and recovered with an absolute accuracy of ± 0.2 g./100 ml.

By using our own monospecific rabbit antisera the presence of the paraprotein was confirmed by immunoelectrophoresis as an M bow of only one type of heavy or light chain, or both.

* Lecturer in Chemical Pathology, Postgraduate Medical School, London W.12.