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Gastric cancer in Wales

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EDITORIAL COMMENT Observations that the incidence of gastric cancer varies in different parts of Great Britain have led to a search for environmental factors. This paper is important because it suggests that the variations may be due to genetic rather than environmental causes.

Malignant disease of the stomach is a much commoner cause of death in the people of Wales than in those living in other parts of the United Kingdom. The data from the General Register Officer (McKenzie, Case, and Pearson, 1957) show a standard mortality ratio for deaths from this cause in Wales of 125 to 150 for the years 1950 to 1954 and our own calculations, which will be presented and discussed below, confirm that the crude death rate for cancer of this organ among men and women over the age of 45 is very much higher in Wales than in the remainder of the country. A second observation, perhaps less well known, is that the frequency of this type of tumour as a cause of death is higher in the Registrar General's Standard Region Wales II, which comprises North and West Wales, than it is in his Standard Region Wales I, which comprises the industrial area of South East Wales, the counties of Glamorgan, Monmouth, Carmarthen, and Brecknock. This observation is convincingly illustrated in the recently published National Atlas of Disease Mortality (Howe, 1963).

This regional distribution of cancer mortality, and, because of the notoriously low 'cure rate' in gastric carcinoma, the regional incidence of this type of tumour has excited attention and associations have been noted with peaty soil (Legon, 1952; Griffith and Davies, 1954; Howe, 1959; Stocks and Davies, 1960; Millar, 1961), with low 'hardness' in the water (Howe, 1959; Millar, 1961), with a high concentration of organic carbon in the drinking water (Griffith and Davies, 1954), and with the presence of a larger amount of the trace elements chromium zinc and cobalt in the soil (Stocks and Davies, 1960). Millar (1961), who studied two rural districts in the county of Montgomery, also suggested that there might be an unusual concentration of natural radioisotopes in the water of such high cancer areas and that the higher incidence of cancer might be due to the mutagenic activity of such isotopes.

The present report is based on two observations. The first is that of Legon (1963) who noted an undue preponderance of Welsh names among those dying of gastric cancer in a small area of North Wales. The second, our own, is based on a map we constructed showing the mortality from gastric cancer in different parts of Wales which corresponds closely to the map published by the General Register Office showing the distribution of Welsh speaking in the counties of Wales (Report on Welsh Speaking Population, 1962b). It can be shown that the distribution of gastric cancer follows closely the distribution of the Welsh people and that the high incidence of this type of neoplasm is a racial, *i.e.*, a genetic trait rather than a consequence of local environmental factors.

The major difference in environmental conditions among the inhabitants of England and Wales lies between the urban and rural habitat. In the case of cancer of the lung a glance at the maps on pages 33 and 34 of the Atlas (Howe, 1963) shows a great preponderance of lung tumours in the urban areas and particularly in the centres of the conurbations. The frequency of gastric cancer, on the other hand, shows only a minor degree of variation between the different types of urban areas and the rural areas. The standard mortality indices for conurbations, urban areas of population more than 100,000, urban areas of population 50,000, and rural areas all fall between 90 and 107 and no consistent trend appears to exist. The age-specific incidence rates for the various types of urban and rural areas were calculated separately and were used in the determination of expected death rates from this cause.

Data from the Registrar General's Statistical Review of England and Wales (Part I: Medical Tables) for the years 1958, 1959, 1960, and 1961 were collated for the 13 counties of Wales and the mortality rates calculated against the total male and female population over the age of 45 (Tables I and

TABLE I

MORTALITY FROM GASTRIC CANCER IN MEN OVER 45 YEARS IN THE COUNTIES OF WALES (1958-61)

County	*Mean Male Population over 45 Years (thousands)*	*Cases of Gastric Carcinoma*	*Average Annual Mortality Rate/ 1,000*
Anglesey	8·9	58	1·635
Brecon	10·2	43	1·065
Caernarvon	23·0	178	1·935
Cardigan	9·9	75	1·89
Carmarthen	31·4	174	1·39
Denbigh	31·4	191	1·56
Flint	26·1	133	1·275
Glamorgan	205·8	1,093	1·335
Merioneth	7·0	37	1·32
Monmouth	74·9	339	1·14
Montgomery	8·2	40	1·22
Pembroke	15·9	87	1·365
Radnor	3·6	12	0·835
Mean for England and Wales			0·999

TABLE II

MORTALITY FROM GASTRIC CANCER IN WOMEN OVER 45 YEARS IN THE COUNTIES OF WALES (1958-61)

County	*Mean Female Population over 45 Years (thousands)*	*Cases of Gastric Carcinoma*	*Average Annual Mortality Rate/1,000*
Anglesey	11·1	30	0·675
Brecon	11·3	26	0·58
Caernarvon	32·0	139	1·09
Cardigan	12·8	52	1·01
Carmarthen	36·8	149	1·01
Denbigh	39·4	115	0·76
Flint	32·4	118	0·91
Glamorgan	24·3	822	0·85
Merioneth	8·8	48	1·38
Monmouth	82·0	257	0·78
Montgomery	9·2	41	1·12
Pembroke	18·6	74	1·00
Radnor	4·1	8	0·49
Mean for England and Wales			0·628

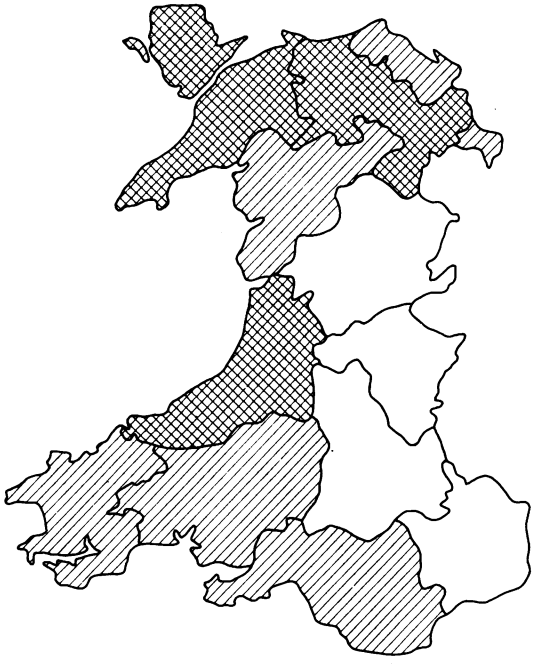
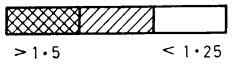


FIG. 1.



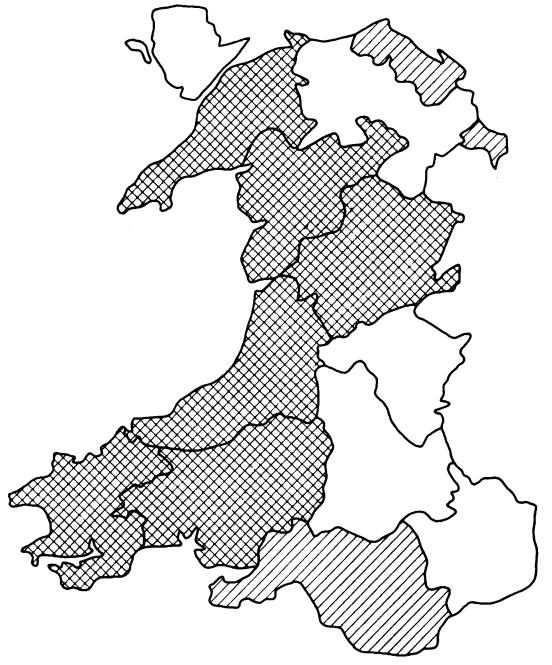
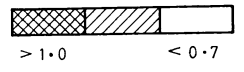


FIG. 2.



FIGS. 1 and 2. *Mortality rates with reference to males and females over 45 years of age, showing the distribution by counties.*

Heavy	*Anglesey*	*Heavy*	*Caernarvon*
	Caernarvon		*Merioneth*
	Denbigh		*Montgomery*
	Cardigan		*Cardigan*
Light	*Flint*		*Carmarthen*
	Merioneth		*Pembroke*
	Pembroke	*Light*	*Flint*
	Carmarthen		*Glamorgan*
	Glamorgan		

II) and these are expressed in graphic form in the outline maps Figures 1 and 2. The mortality rates were calculated with reference to the population over the age of 45 because the vast majority of cases (about 98%) of gastric cancer occur after this age and because the age distributions within the counties were approximately equivalent. Calculation of the mortality rates with reference to the population over the age of 65 gave results which showed similar trends and both corresponded with the maps drawn on the basis of standard mortality ratios by Howe (1963). In each case the counties of Caernarvon, Merioneth, Cardigan, Carmarthen, Glamorgan, and Pembroke showed a high incidence of gastric cancer while Monmouth, Radnor, and Brecon had a low mortality from this disease.

The Registrar General's Report on the Welsh Speaking Population (1962b) shows that the country can be divided into areas according to the percentage of persons who, at the 1961 census, claimed to be able to speak Welsh. In the counties of Anglesey, Caernarvonshire, Cardiganshire, Carmarthenshire, and Merioneth over 70% of the population were Welsh speaking, and in Brecknock, Denbigh, Flint, Glamorgan, Montgomery, and Pembroke and in the county boroughs of Merthyr Tydfil and Swansea between 15 and 45% of the population claimed to be Welsh speaking, while in the counties of Monmouth and Radnor and in the county boroughs of Cardiff and Newport less than 10% of the population were Welsh speaking (Fig. 3).

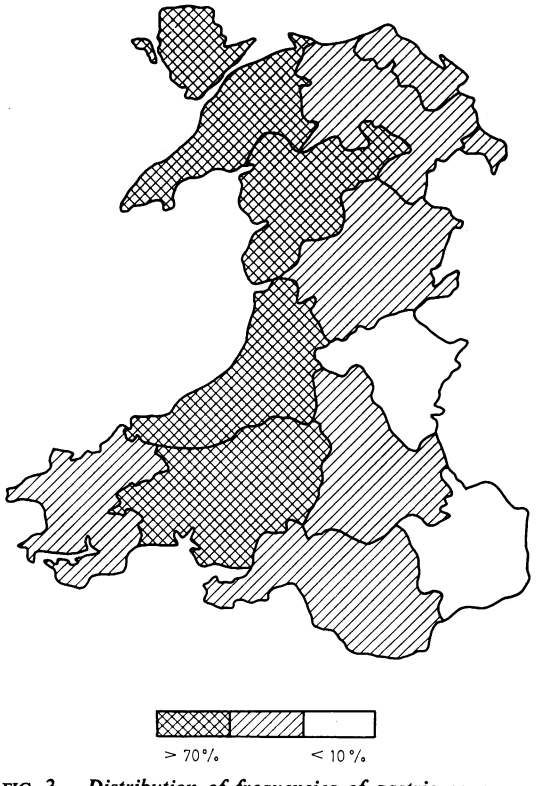


FIG. 3. *Distribution of frequencies of gastric cancer according to Welsh-speaking areas.*

Heavy	*Anglesey*	*Light*	*Flint*
	Caernarvon		*Denbigh*
	Merioneth		*Brecon*
	Cardigan		*Pembroke*
	Carmarthen		*Glamorgan*

This distribution corresponds well with the distribution of the frequencies of gastric cancer in men and women. The numbers of deaths from gastric cancer for these three areas of Wales were extracted from the Registrar General's Annual Reports for the years 1958 to 1963 and compared with the expected numbers had the mean death rates in the whole of England and Wales applied to the Principality (Table III). The ratio between observed and expected deaths in the high Welsh speaking area was 1·67 for men and 1·69 for women. In the intermediate area where the frequency of Welsh speaking was between 15 and 45% the ratios were 1·38 for men and 1·40 for women. In the remaining area where Welsh was spoken by less than 10% of the population the ratios were 1·12 for men and 1·31 for women. A clear association is seen between the frequency of Welsh speaking in the population and the death rate from gastric cancer.

TABLE III

GASTRIC CANCER DEATHS (1958-62)

Percentage Welsh-speaking	*Male*			*Female*		
	Observed	*Expected*	*Ratio*	*Observed*	*Expected*	*Ratio*
>70	641	383	1·67	512	303	1·69
15-45	1738	1260	1·38	1287	918	1·40
<10	688	612	1·12	568	432	1·31

The population of Wales in each area is heterogeneous, comprising the Welsh descended from the longstanding inhabitants of the Principality and the immigrants who have arrived mostly within the last hundred years. These two groups can be separated, in males and unmarried females, on the basis of the surname. The surnames of Wales are few in number and are characteristically derived from Christian names by the use of the genitive case, Davies, Williams, and Owens for example, or by elision of the prefix Ap, the son of, to form such names as Pugh, Parry, and Pritchard. By contrast the English surname is more often derived from a place name as is Ashley, from an occupation, Smith or Turner, or from a nickname, Armstrong, Small.

Data were collected from 558 men living in the

Swansea area to verify this suggestion. There was a strong and significant association between having a Welsh surname and the ability to speak Welsh in the men questioned and also their fathers and mothers (Table IV). The surnames regarded as

TABLE IV

ASSOCIATION BETWEEN WELSH NAME AND WELSH SPEAKING

Subjects		*Welsh Speaking*	*Non-Welsh Speaking*
	Welsh name	199	123
	Non-Welsh name	47	189
Fathers	Welsh name	236	94
	Non-Welsh name	55	171
Mothers	(maiden name)		
	Welsh name	216	77
	Non-Welsh name	57	160

Welsh were 96 in number (Appendix) and were selected from lists of Welsh names such as that of Watkin (1956), from lists suggested by various colleagues, and from our general knowledge of the Welsh people and their names. A Welsh surname was also strongly associated with Wales as a birthplace. In 100 of the 236 families with non-Welsh surnames some member was born elsewhere than Wales and in 30 of these all members were born outside Wales. In contrast, of 322 families with Welsh surnames only 32 had a member born outside Wales and in only one instance had all members of the family been born elsewhere than Wales.

Additional data were sought from a study of four populations regarded by us as highly selected for Welshness. In the list of officials of the National Eisteddfod of 1963 at Llandudno 209 names were recorded. Of these, 177 were included in our list of Welsh names and only 32, each of which was represented only once, were not. The latter included adjudicators for competitions in some of the less typically Welsh crafts. A similar analysis of the names recorded in the membership list of the Gorsedd for 1963 showed 814 names, of which 738 were included in our list of Welsh names and only 76 were not. In eight instances a non-Welsh name appeared more than once in the list.

A collection of annual reports from Welsh-speaking chapels was made available to us by the Department of Social Sciences at the University College of Swansea. It was felt that membership of such a chapel was probably one of the strongest indices of Welshness which could readily be obtained, and the reports were scrutinized to determine the proportion of members bearing names which we had selected as Welsh. In these chapels services and business are conducted in the Welsh language and there is a pronounced tendency to uphold Welsh cultural traditions. Many chapel members and ministers are officials of the national and local Eisteddfodau and are interested in the Welsh language, newspapers, and books which are presently published. Sixty-nine ministers were appointed to the chapels whose reports were available. Sixty-two of these (90%) had names included in our list. The lay officers of the chapels, the deacons, also showed a great preponderance of Welsh names. Out of a total of 830 names recorded, 713 (86%) were included in the list of Welsh names. Similarly the lists of subscribers of nine of the larger congregations were examined and showed that 1,458 out of 1,818 (80%) had names included in our list of Welsh names.

In the County Borough of Swansea there are two Welsh schools in which the teaching and all school business is conducted in Welsh. The criterion for accepting a child at one of these schools is that Welsh shall be the language of the home. It is our view that, in addition, the parents, who must make a special request for their children to be educated in this way, are strongly oriented towards the Welsh language and culture. Analysis of the roles of these two schools shows that of 268 children on the register 204 (76%) had names which we included in a provisional list of 34 of the commonest Welsh names.

Mr. C. C. Harris, of the Department of Social Science, University College, Swansea, very kindly made available to us some data from a survey of a 2% sample of the population of Swansea made in connexion with a separate piece of research (Rosser and Harris, 1965). These data were analysed in respect to the subsample of the 34 commonest Welsh names, marked in the Appendix. Table V

TABLE V

GASTRIC CANCER CASES IN MALES IN THE GLANTAWE AREA

Residence	*Welsh Name*	*Non-Welsh Name*	*Total*	*Welsh Name Expected*
Carmarthen	30	8	38	24·8
West Glamorgan	41	16	57	30·8
Swansea	54	40	94	41
Totals	125	64	189	96·6

shows that the proportion of individuals with Welsh names was slightly higher in the group designated stable middle class, *i.e.*, those men in middle-class occupations whose parents were in the middle class, than in the group of stable working class, *i.e.*, the group in which the men were of working class occupations and their parents were also of working class occupations. This difference is not statistically significant. Classification of the present occupation under the Registrar General's classification shows

no significant difference between the proportion of men with Welsh names in occupations of Registrar General's classes I and II and the Registrar General's classifications IIIb, IV, and V. The income levels of the groups with and without Welsh names were almost identical. In the case of men under 50, those with Welsh names had a mean income of £13·79 per week, those with non-Welsh names had a mean income of £13·73 per week. In the case of men over 50, those with Welsh names had a mean income of £11·61 per week, those with non-Welsh names had a mean income of £11·78 per week.

This parameter of Welshness was applied to the members of a series of 189 cases of gastric carcinoma in males attending this hospital and Swansea General Hospital (Table V). The frequency of 'Welshness' in the population differs in the three topographical areas from which the hospital population is drawn, the eastern part of the county of Carmarthen, the county borough of Swansea, and the western part of the county of Glamorgan. The number of Welsh names expected was calculated for each of these areas separately from a control series which comprised a 2% sample of the names on the electoral registers of the areas concerned. There is an excess of Welsh names in each area which is statistically significant.

A similar analysis was carried out on the death notices for the year 1963 obtained from the Registrar General. Three hundred and seventy-three deaths from gastric cancer were certified in this period among men in the counties of Carmarthen, Glamorgan, and Monmouth and their four included county boroughs. One hundred and eighty-eight of these men had names included in our list of 96 Welsh names while, by comparison with the number of Welsh names among those listed in the electoral registers, 155·9 of these men would have been expected to have Welsh surnames (Table VI).

TABLE VI

GASTRIC CANCER DEATHS IN MALES (1963)

Residence	*Welsh Name*	*Non-Welsh Name*	*Welsh Name Expected*	
Carmarthen	31	6	24·2	
Glamorgan	76	52	58·3	
Monmouth	39	38	29·2	
Swansea	20	29	21·4	
Cardiff	10	48	14·7	
Merthyr Tydfil	6	2	4·3	
Newport	6	10	3·8	
Totals	188	185	155·9	d 32·1

These two observations, the higher incidence of gastric cancer in the areas of Wales in which Welsh was spoken frequently, and the higher frequency of Welsh names among men with carcinoma of the stomach than among a control population of men in the same age groups, indicate that the high incidence of death from malignant neoplasm of this viscus in Wales is related to a peculiarity of the population rather than to differences between the environment in which the inhabitants of Wales and of England live.

The study was further extended by consideration of the major regions of England and Wales. The annual review of the Registrar General for the year 1963 (Registrar General, 1965) gives the standardized mortality ratios for malignant gastric neoplasms for the standard regions of England and Wales. These are extracted in Table VII. A significantly higher ratio was seen in the two Welsh regions and in the northern and north western regions. Significantly lower ratios were seen in the eastern and southern parts of the country. Reference to Howe's maps (Howe, 1963) also shows a high mortality from this disease in south west Scotland and Northern Ireland.

TABLE VII

STANDARDIZED MORTALITY RATIOS FOR GASTRIC NEOPLASM IN THE STANDARD REGIONS (1963)

Region	*Males*	*Females*
Northern	116	123
East and West Ridings	110	109
North Western	115	113
North Midlands	94	99
Midlands	103	109
Eastern	88	80
London and South Eastern	88	87
Southern	87	77
South Western	88	88
Wales I	118	145
Wales II	145	145

DISCUSSION

It is our contention that the data presented and analysed in this paper show that the widely acknowledged high incidence of gastric carcinoma in Wales is primarily due to racial, and therefore genetic, factors rather than to environmental causes whether geological, meteorological, hydrological, occupational, or gastronomic. The frequency of death from gastric carcinoma, and hence, because of the extremely poor prospect of curative treatment of this disease, the overall incidence of this neoplasm, is higher generally in Wales than in the remainder of the United Kingdom and is highest particularly in those parts of Wales in which the ancient Welsh language and culture play a prominent part in daily life. The association of a high incidence of gastric cancer with a high frequency of Welsh speaking in the population is apparent from the outline maps

(Figs. 1, 2, and 3) and the statistical analysis of Table III.

The association could still, however, be fortuitous and be due to the accidental association of the Welsh culture with some, as yet unknown, peculiarity of the soil, water, or food of these areas. The further analysis of cases of gastric carcinoma coming from a small area of South Wales, in which there are few or no differences of environment and where the Welsh and non-Welsh work side by side in the local industries, demonstrates that it is the characteristic of 'Welshness', here defined by the possession of a Welsh surname, which is associated with an increased frequency of gastric carcinoma. A similar observation in North Wales (Legon, 1963) confirms the association. Beasley (1963), who had previously reported (1960) an increased frequency of the blood group antigen A in cases of carcinoma of the stomach in Monmouthshire, was unable to confirm the excess of Welsh names noted by Legon and ourselves. His data were, however, collected in the county of Wales in which the smallest proportion of the populations are Welsh speaking and in which the incidence of gastric cancer most closely approximates to that of the neighbouring parts of England. His population is less 'Welsh' than that of the more westerly counties of the Principality, probably because it is nearer to England and is the centre of much industry which has attracted immigrants of the less susceptible eastern race.

Racial differences in the frequency of tumours are well known, although usually the ethnic groups concerned derive from widely different parts of the earth. Kouwenaar (1951) reported different frequencies in the plantations of the East Indies; here the racial differences were great and indeed apparent to the naked eye, and there was also a difference of culture in culinary habits. A survey of tumours among the different ethnic groups represented in the population of Buffalo, New York (Graham, Levin, Lilienfeld, and Sheehe, 1963) showed a greater risk of gastric cancer among foreign-born women, especially those who immigrated from Poland, than among native-born American women, and there was a similar greater risk of stomach cancer among Polish-American men. In this case too the possibility of an environmental difference between the food and cooking of the immigrants and the native Americans could not be excluded, and indeed the American workers suggested that their conclusions should be followed by a systematic consideration of the diet and cooking of the different groups of immigrants. Within the single small Principality of Wales, however, environmental differences and differences in culinary habits are minimal. The Welsh, driven westward by the successive waves of invaders from the east, have in the last century or so absorbed most of the material culture of the remainder of the British Isles while retaining their language and literary culture, their own variety of Christian observances, and their genetic structure. Watkin (1956) found a rather higher incidence of the ABO blood group O in Wales than in the neighbouring counties of England, and our own unpublished observations on blood group show a different pattern for the ABO series between the men with Welsh names and those with non-Welsh names in South Wales. We consider that, having regard to the evidence of the association of a high frequency of gastric cancer with Welsh speaking, the association with Welsh surnames, and the minimal environmental differences within the borough of Swansea and the comparatively small surrounding area, a major reason for the difference in mortality from gastric cancer between the people of Wales and the people of England lies in the genetic constitution of the Welsh, *i.e.*, that they are more susceptible to or less resistant to gastric cancer than the English.

Consideration of the data for the remainder of the United Kingdom shows a higher frequency of gastric cancer in the north and north west and also in south west Scotland and Northern Ireland. This we suggest may be due to the immigration of Welsh and Irish into the northern part of England and to the ethnic similarity between the Welsh, the Irish, and the south western Scots reflected otherwise by the similarity of their languages.

The establishment of a racial factor as one of the important determinants of susceptibility to this type of tumour raises many questions on the method by which genetic factors operate. It also leaves open the possibility of eliminating the effect of race, by studying the relative death rates of the Welsh in various areas of Wales and of the non-Welsh in various parts of the Principality. From such data a better index of the geographical distribution of environmental factors operative in the aetiology of gastric cancer may be obtained and a more logical search may be instituted.

SUMMARY

A high incidence of gastric carcinoma in Wales has been noted. Detailed analysis shows that the highest frequency of this disease is seen in the areas of Wales where Welsh is spoken most and that there is a correlation between the incidence of stomach cancer and the proportion of the population who speak Welsh.

Analysis of a local series of cases of gastric cancer shows that there is an undue preponderance of Welsh names among such cases when compared with the control population of hospital patients.

It is concluded that there is, in the Welsh, an increased susceptibility to stomach cancer and that this is a racial, genetically determined, characteristic. Observation of high death rates from gastric cancer among the people of the north and north west of England, in Northern Ireland, and in south western Scotland suggests that this propensity is shared by the Celts domiciled in England and also by the Hibernian Celts.

This work was carried out during the tenure of a research grant from the Welsh Hospital Board. It formed the substance of an exhibit at the 1965 Annual Scientific Meeting of the British Medical Association.

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APPENDIX

A LIST OF WELSH NAMES USED IN THE SURVEY

Adda	Griffith	Morgan
Anwyl	Gronow	Morris
Baynham	Gwatkin	Owen
Bevan	Gwilt	Parry
Beddoe	Gwilym	Phillip
Bellis	Gwyn	Powell
Beynon	Gwyther	Powis
Bithel	Harris	Price
Blythin	Hopkin	Pritchard
Bowen	Howell	Probert
Breeze	Hughes	Probyn
Cadarn	Humphries	Prosser
Caddell	Idris	Protheroe
Cadwallader	Ithell	Prytherch
Craddock	James	Pugh
David	Jenkin	Rees
Davies	John	Richards
Dilwyn	Jones	Roberts
Edmonds	Joseph	Rogers
Edmunds	Kenwyn	Rosser
Edwards	Kyffin	Rowlands
Elias	Lewis	Thomas
Ellis	Leyshon	Treharne
Evans	Llewellyn	Trevethan
Eynon	Lloyd	Tudor
Foulk	Loughor	Vaughan
Foulkes	Machen	Walters
Francis	Maddock	Watkins
George	Mainwaring	Welsh
Gethin	Mathias	Williams
Glyn	Meredith	Wyn
Gough	Meyrick	Yorath