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# THE DEVELOPMENT OF SCIENCE AND TECHNOLOGY IN A CIVIC UNIVERSITY: LIVERPOOL 1881-1914

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This article describes the financial difficulties encountered by the founders of University College, Liverpool in the face of the parsimony and indifference of the central government. Owing to the costs involved these difficulties were particularly acute in the sciences and technologies. The article illustrates the extent to which leading citizens were prepared to make personal sacrifices to support the new institution, motivated in no small part by their awareness of the great strides made in German higher education and its influence on that country's growing industrial strength. The article also deals with another problem that was encountered, namely, that of creating and maintaining 'university standards' against a background of deficient secondary schools and a dearth of scholarships. Finally, the role of research and changing attitudes to it are considered.

University College Liverpool, in common with the other civic universities was created in response to both national and local needs: it was to provide its citizens with an alternative education to the 'liberal' education found at Oxford and Cambridge and at the same time it was designed to produce the trained scientific and technical manpower the country needed for the commercial and industrial struggles with its competitors. On all sides the desire for a University College was based not only on an educational need but sprang also from commercial, industrial and economic needs.

The turning point in the movement to found a College came at a Town Meeting called by the Mayor on 24th May, 1878, when it was resolved:

> That it is desirable that a College be established in Liverpool to provide such instruction in all branches of an education as will enable residents in the town and neighbourhood to qualify for degrees in Science and

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> Arts and at the same time to give such technical instruction in physics, engineering, navigation, chemistry and allied subjects as should be of immediate service in professional and commercial life (7)

At this meeting a Committee was formed 'for the purpose of arranging a plan for bringing under the notice of the public the desirability of establishing a College of Science in Liverpool In canvassing support, the Committee met with the objections that the times were bad and that liberal donations to the Bishopric and other funds had exhausted resources Undeterred, the Committee appealed widely to all leading men connected with literature, art and science, support was immediately forthcoming and guarantees to the value of £60,000 were obtained for the endowment of six chairs The site chosen for the College was dependent on the fact that the London and North Western Railway had decided to open up their tunnel to Edge Hill and in doing so they had to expose a deep cutting through the Lunatic Asylum grounds and as a result the building and recreation grounds of the Asylum became available, these were bought for £19,000 by Mr Thomas Cope and were presented as a loan to the College At this point the Corporation of the City of Liverpool lent a helping hand, it applied to Parliament for power to raise the sum of £30,000 to be expended on the purchase of land and buildings secured by the College A Charter of incorporation empowering the College to own property in its own right was granted in October 1881 and the College opened for day and evening classes in January 1882

When the College began, five chairs were created, three of which were in the sciences, namely, experimental physics and mathematics, chemistry and natural history Shortly afterwards, separate chairs of mathematics and of physics were created and, in 1888, a chair of engineering was added By the end of the first term the Registrar was able to announce that over five hundred students had attended classes at the College but the evening classes were the more popular and fewer than a hundred students registered for the day classes Initially, the bulk of the work was of a very low standard, for many years the minimum age of entry was as low as fifteen and the College provided classes for students under the age of sixteen who were sitting the 'preliminary examination' The few students at the College who pursued degree courses sat the examinations of the University of London as the University College was not empowered to confer degrees on its students This was remedied when the College became a constituent College of the federal Victoria University of Manchester in 1884

In 1906, Ramsay Muir who was the first holder of the Chair of Modern History in the University of Liverpool wrote *The University of Liverpool: Its present state.* In it he said,

> The setting up of Liverpool University was a heroic enterprise many thought, and some, perhaps, still think, it was a hopelessly quixotic enterprise to attempt to plant a great University in a city like Liverpool. The initiators had to anticipate a flood of ridicule and depreciation from critics without faith or imagination. The upper classes would not dream of sending their children to it to sit beside the sons of tradesmen. As for the latter, the habit of expecting their children to earn money at an early stage was very deeply rooted in the district. Further, secondary education in this district was in an extremely backward condition so that the majority of the students who came were ill-prepared (6, p.1).

> How could the generosity even of Liverpool merchants hope to rival the millions with which private and public munificence has endowed the universities of America or the lavish subsidies with which the State in Germany maintains the institutions which are in the country regarded as the pillars of national greatness? (6, p. 6).

## SOURCES OF COLLEGE INCOME

When University College was founded, £80,000 was raised by public subscriptions in and around Liverpool. Thereafter, the sources of finance open to the University College, and later the University, were four-fold – the government, local authorities, students' fees and private donations. In the formation and running of the civic universities during the nineteenth century local factors predominated. The apathy of the central government on the one hand and the resistence to state aid on the other led to the universities being autonomous and virtually independent of state support. In 1889, the government made £15,000 available to English universities, Liverpool's share of which was £1,500. The townspeople of Liverpool raised £170,000 at the time of the conversion of University College to a University in the early 1900s. By comparison, the total government grants to University College and the University between 1889 and 1914 was £156,900. The government grant did not exceed income from endowments and donations until 1905.

Another source of public funds for the University was the local authorities. As a result of the 1890 Local Taxation Act, substantial sums

of money were placed at the disposal of the City Council for the purposes of technical instruction A Technical Instruction Sub-Committee, set up to distribute these funds, immediately allocated £750 to the physics department, £250 to the engineering department and £250 to the chemistry department An interesting venture which qualified for support from the Sub Committee was the programme of Penny Technical Lectures for work people These were conducted by Professor Hele Shaw, the first Professor of engineering at University College, and conducted in the Walker Engineering Laboratories They ran for many years and were attended each session by several hundred apprentices and artisans In 1904, following the reorganisation made necessary by the Education Act of 1902, the Sub-Committee became the Technical Sub Committee of the Education Committee of the City Council Grants were continued to be made by Liverpool and, by this time, other authorities such as Birkenhead, Wallasey, Bootle, and Lancashire and Cheshire County Councils also gave grants In 1913, for instance, local authorities contributed £11,916 which accounted for 14% of the total income for the session

Throughout the period 1881 1914, students' fees constituted a consider able proportion of the annual income of University College and of the University Scholarships were few and it was well into the twentieth century before a substantial 'ladder' had been created enabling bright boys from impoverished circumstances to pass by means of scholarships through the various stages of the educational process While many were of the view that a reduction in the scale of fees would be highly desirable, and some went as far as to advocate their total abolition, the prevailing belief was that it would be impossible to work the University efficiently without the income from fees Clearly there was a considerable dependence on this source of income (see Table 1) and such a policy must have penalised many students who were capable of benefiting from a university education but were debarred because of the high fees involved

For any educational institution to be successful in the nineteenth century it was essential for it to be adequately endowed Table 1 indicates the extent to which the University relied on donations and subscriptions These formed one of the main sources of financial support and fortunately the generosity of the merchants and industrialists of Liverpool enabled the College to be well-endowed by English standards A significant proportion of the annual income came from private sources but, in addition to the annual income, the creation of chairs was also largely dependent on endowments and the building of laboratories, too, was the outcome of generous

TABLE 1

SOURCES OF ANNUAL INCOME OF UNIVERSITY COLLEGE, LIVERPOOL, AND OF THE UNIVERSITY OF LIVERPOOL, 1894 1914

| | 1894/05 | 1900/01 | 1905/06 | 1913/14 |
|---|---|---|---|---|
| Percentage of annual income derived from Treasury Grants in Aid and other Government sources | 9 | 12 | 42 | 32 |
| Percentage of annual income derived from local authorities * | 12 | 5 | 19 | 15 |
| Percentage of annual income derived from Technical Instruction Fund † | 10 | 7 | 8 | 4 |
| Percentage of annual income derived from fees | 34 | 50 | 24 | 25 |
| Percentage of annual income derived from endowments and donations | 35 | 26 | 9 | 24 |
| Total annual income (Approx ) | £17,000 | £25,000 | £61 000 | £84 000 |

* As well as Liverpool and Lancashire other local authorities who contributed were Bootle Cheshire Birkenhead, Wigan and St Helens

† Grants donated by Local Authority Technical Instruction Committees from funds made available to them by the Technical Instruction Act of 1889 and the Local Taxation Act of 1890

gifts from groups of individuals From private sources came over £150,000 for the creation of chairs in science alone and £250,000 for buildings Hence, discounting annual income, which was used for the general expenses of running the College, at least £400,000 was donated by private individuals for specific purposes in science and engineering None the less, there were still serious disadvantages While wealthy merchants and industrialists were prepared to endow chairs, it was left to the College to find money for the junior posts out of general funds The consequence was that there was a dearth of junior posts

At the same time, the College was forced to rely on the generosity of a benefactor providing an endowment before a new chair could be created This delayed the creation of necessary chairs and notable omissions for many years were chairs in metallurgy, geology, mechanical engineering and organic chemistry Laboratory space was always at a premium and research facilities were insufficient and madequate

The annual income rarely met the needs of the expanding College and to make up the deficiency a special Sustentation Fund was set up which was composed of special donations from friends of the College. In Muir's view this formed:

> a precarious and undignified means of supporting a great institution. A university should not have to depend upon charitable subscriptions. Even with the Sustentation Fund, however, it is found impossible to make both ends meet. On the last financial year there was a deficit of £1,250 and the total accumulated debt amounts to over £11,000 (5).

The Sustentation Fund merely placed a further burden on the shoulders of the comparatively small number of influential individuals who made frequent and substantial contributions for the support of the College.

## STAFF DEVELOPMENTS

It was stated earlier that when University College was established five chairs were instituted and of these three were in the sciences. By 1914, there was a scientific and engineering staff of sixty, thirteen of these being professors. Between 1890 and 1900, the scientific staff doubled and it doubled again between 1900 and 1910, the largest increase (50%) occurring between 1905 and 1906.

When University College began in 1882, professors were appointed in mathematics and physics, in chemistry and in natural history. The first appointment in engineering was made in 1885 when H.S. Hele-Shaw (a civil engineer) was appointed a lecturer in that subject. As a young apprentice in a workshop, Hele-Shaw had won a Whitworth Scholarship which enabled him to study at the College of the West of England, Bristol, where he distinguished himself academically and ended up as professor of mathematics. In 1886, he became the first professor of engineering at Liverpool, a position he held with distinction for two decades. In 1889, Hele-Shaw was given two assistant lecturers and a departmental lecturer was appointed in electrotechnology. The status of this post was upgraded in 1903 when the then lecturer, W.E. Marchant, became the first David Jardine Professor of Electric Power Engineering, one of the first appointments of its kind in the country. The first appointment in mechanical engineering was made in 1883 when W.E. Kerslake became assistant lecturer. By 1908, the staff of the Engineering Faculty had increased to nine, by which time there were three professors. But in addition there were several supernumary appointments

and the University had taken a considerable initiative in bringing into the University several associate professors from among leading engineers outside the University walls. The City Engineer was appointed Associate Professor in Municipal Engineering; the Manager of the Lancashire and Yorkshire Railway was made an Associate Professor of Railway Engineering; the City Electrical Engineer became Associate Professor of Municipal Electrical Engineering; the Engineer-in-Chief of the Mersey Docks and Harbour Board was made Associate Professor of Docks & Harbour Construction. Another interesting innovation took place in 1910 when a Chair of Naval Architecture was created. By 1913, the staff of the Engineering Faculty comprised one third of the total staff of science and technology in the University.

At its foundation the College appointed a Professor of Chemistry. Two demonstrators were added to the staff in 1886 and three assistant lecturers in 1891, one in organic chemistry. This was the first and only appointment in this subject prior to 1915 when a chair was created. In 1893, Dr D.T.L. Bailey was appointed Demonstrator and Assistant Lecturer in Chemistry; three years later his title was changed to Lecturer in Metallurgy. In 1903, through the generosity of Sir John Brunner, a Chair in Physical Chemistry was established. In academic terms, the chemists were the best qualified staff in the Science Faculty, most of the members possessing a PhD degree and several a DSc degree.

The University achieved a unique distinction when, in 1902, it created the first Chair of Biochemistry in the country. There was soon a large and thriving Department devoted purely to research and postgraduate studies. During its early days most members of staff were medical men, but with time they were gradually replaced by trained chemists.

In the biological sciences, a Chair of Natural History was created at the foundation of the college to which William Herdman was appointed. In 1889, as the result of an endowment by Holbrook Gaskell, a chemical manufacturer from Widnes, a separate Chair of Botany was set up. Harvey Gibson who had come to the College as a Special Lecturer in Botany in 1884 became the first holder of this chair. Prior to 1889, Harvey Gibson was variously described in the College Calendars as a Special Lecturer, a Demonstrator and as a Lecturer. During those early days, the titles of lecturer, demonstrator and assistant lecturer seem to have been interchangeable and in fact the most usual title given to junior staff was that of 'Demonstrator and Assistant Lecturer'. These different titles do not seem

to have implied the differences in status and responsibilities that would nowadays be associated with them

It is clear from this very brief account that engineering received the emphasis the College founders intended It was in this discipline, and to a lesser extent in chemistry, that the College broke away from the Oxbridge traditions This break is also seen in the low status given to the role of geology in the College which was in marked contrast to the prestige of the subject at Oxford, Cambridge and the two London Colleges, University College and King's College At Liverpool there was no chair in geology until 1916 There were, it is true, lecturers in geology 'as it applies to engineering, mining and chemical industries' which began in the late 1880s These were given by Joseph Lomas who came to Liverpool in 1886 as an Assistant Science Demonstrator to the School Board Although his association with the College both as teacher and researcher stemmed from that date he held no full time post until his appointment as Lecturer in Physical Geography in 1903

## BUILDINGS AND LABORATORY FACILITIES

The original home of the College was in the former Lunatic Asylum, adjacent to the Royal Infirmary, which had been acquired with its grounds and some small adjoining properties thus giving virtual control of an extensive area It was on this campus that, between 1881 and 1914, some quarter of a million pounds worth of laboratories were built

The chemistry laboratories, opened in 1886, formed the first buildings erected specifically for the University The cost was £21,000, a sum which came from a number of sources The first section was erected by a Committee of the Manufacturers and Traders of Liverpool and district whose members gave sums ranging from ten shillings to £1,000 each This portion was opened in May, 1886, but the erection of the main laboratories was not then proceeded with, partly owing to the lack of funds and partly because a portion of the site given by the Corporation was not vacant In the early years of the College the number of advanced students was few but by 1891 the practical rooms were overfull In 1885 6, for instance, there were 81 junior students but only 8 advanced students, by 1887-8 these numbers were 105 and 28 respectively By 1893, there was a great need for further accommodation and eventually the Gossage laboratories were erected in 1896

By 1901 2, the Gossage laboratories in turn were overcrowded Sir John Brunner, in appealing for extra funds, emphasised that it was necessary to beat the Germans A right step in this direction was taken in 1903 when the physical laboratories were built out of funds contributed by E K Muspratt Mr Ramsey Muir pointed out that

> These are the only laboratories of their kind in England, Mr Muspratt, himself a scientific chemist, knew that this branch of chemistry was to become of increasing importance to the industry of England, and he has ensured that his own city should be ahead of all England in meeting this new need This has placed Liverpool in the forefront of English cities in the provision of the most complete facilities for advanced studies, especially for those studies upon which national efficiency depends (6)

The first single gift of great magnitude that the College received was that of Sir Andrew Walker for engineering Prior to the opening of the Walker laboratories in 1888, temporary premises had been used for four years In all, Sir Andrew Walker contributed £23,000 for the engineering laboratories This was quickly followed by a gift of £10,000 by Thomas Harrison for the permanent endowment of a Chair of Engineering Thus

> Within two years of its provisional creation upon the strength of temporary guarantees the Department of Engineering was equipped upon a scale unsurpassed at any College or University in the United Kingdom (8)

Engineering received another outstanding gift in 1910 when a number of leading shipping merchants combined to present £35,000 for engineering laboratories W H Watkinson, Professor of Civil Engineering, spoke at the laying of the foundation stone

> In the development and utilisation of engineering laboratories the Germans have undoubtedly been ahead of all other countries and when I visited their principal laboratories two years ago I found they were still developing, and at a more rapid rate than we were doing in this country This was most noticeable at Charlottenberg, Dresden, Darmstadt, Carlsruhe and Stuttgart In the United States and Canada their gigantic laboratories are being extended Both the Germans and United States realise far more than we do the value of university training for engineers It is appropriate that in the University's new laboratories we should make

special provision for teaching and research work in those branches of engineering which are likely to contribute most to the prosperity of engineering We intend therefore, that the equipment in marine engineering, internal combustion engines, steam turbines, fuel testing and refrigeration should be second to none in Great Britian It is humiliating that the names associated with the invention of internal combustion engines are, almost without exception, all German – Langen, Otto, Daimler, Korting, Ochelhausser, Diessel – and nearly all the large internal combustion engines which are being built in this country today are being built under licence from Germans The design of internal combustion engines involves greater scientific knowledge than the design of steam engines, and it seems reasonable to conclude that the greater success of the Germans in the invention and design of these engines is directly due to their better training in scientific principles The adoption of internal combustion engines for warships would enormously increase their fighting power, and our greatest danger at present is that the Germans will be able to produce battleships propelled by internal combustion engines before we can do so in this country it will take half a generation to enable us to overtake the Germans in the training of engineers (3)

Although the Lyon Jones Chair of Physics had been one of the first of the chairs created at the commencement of the College, this subject, as far as laboratory accommodation was concerned, was very much neglected This deficiency was corrected when on November 12, 1904, Lord Kelvin officially opened the new George Holt Physics Laboratories erected at a cost of £24,000 Contributions came from a representative cross-section of the City's leaders including Sir Henry Tate and Sir John Brunner

Less than a year after the opening of the physics laboratories, the electro technics laboratory was opened by Sir Joseph Wilson Swan This was known as the Jardine laboratory, for Sir David Jardine donated £10,000 towards its cost A further £1,000 was contributed by the Lancashire County Council, but £12,000 was also taken out of the University Fund in order to finance it The basement of this building, like that of the Holt Laboratory, was set aside for research At a dinner at the Adelphi to celebrate the opening of the laboratories E K Muspratt remarked

We are constantly being told that gradually the Germans are going to dispossess England of her supremacy in trade and commerce In face of this assertion there is a great outcry in England 'we must have technical education' as if technical education had made Germany (9)

He claimed that it was not technical education but university education which had brought about the transformation of Germany Sir William Siemens also spoke at the dinner and said that what had secured for England a leading position in the past was that the individual man was not afraid to act for himself However, he was of the opinion that this could be overdone for a great argument in England always had been that the people said 'what was good enough for my father is good enough for me', that was a certain brake on progress

Many of those who were foremost in the affairs of the College also played a notable part in the national debate then going on as to the causes of Britain's industrial decline relative to her competitors They were well aware of the struggle with Germany and it is clear that they were anxious for the College to play its part in providing the trained manpower the country so badly needed as well as for it to serve localised educational needs

As one would expect, the biological sciences did not compare favourably with the physical sciences and technologies Accommodation in this field was meagre and inadequate and suitable accommodation was not provided until the early 1900s The College did of course possess a number of laboratories in related fields which contributed to the scientific teaching and, perhaps equally important, to the prestige of the fledgling institution These included the Thomson Yates Laboratories of Physiology and Pathology opened in 1898 and the School of Tropical Medicine also opened in that year, one of only two in the country

The complex of up to date laboratories possessed by the College in the mid 1900s (by that time a University) had, said Muir

> placed Liverpool in the forefront of English cities in the provision of the most complete facilities for advanced studies and specially for those studies upon which national efficiency depends (6)

## UNIVERSITY STATUS AND STANDARDS

During the 1890s University College expanded rapidly Standards were raised gradually and provision was extended both in range and depth Leading citizens were now of the opinion that the College deserved to be ranked as a University A campaign was mounted and £170,000 was collected from gifts and subscriptions Parliament was petitioned and the College duly received its University Charter

By 1903, the year that University College received a University Charter, Liverpool had developed an extensive range of scientific and technical subjects, Cambridge could not offer anything like the range of sciences and technologies studied at Liverpool, Leeds and Birmingham On the other hand these institutions, for the first decade after their emergence as Colleges of one description or another, were little more than secondary schools This is certainly true of Liverpool at least and it is difficult to be exact as to the time when transition to University status occurred but it probably took place between 1895 and 1905 for between these dates the number of students and staff had both doubled and in addition other significant changes had taken place

Along with all other higher institutions of learning in the nineteenth century the University College of Liverpool suffered from the absence of efficient systems of primary and secondary education As we have seen, during its early years the work was of a very low standard and many students were only 15 or 16 years of age During the last two decades of the nineteenth century much of the work of the College was of secondary school level as many students were obliged to matriculate at the College as they had not done so at school In the early 1890s about 25% of the students had not matriculated and for these the College arranged special courses of study and examinations known as the 'Preliminary Examinations' Up to 1903 students were allowed to count a year's work for the preliminary examination as part of the three years required to qualify for the degree and the classes for this, which was really school work, were the largest in the College One of the conditions attaching to the University Charter granted to the College in 1903 was that this matriculation work should cease One consequence of the students being ill prepared was that large numbers had to matriculate while actual students at the College, another was the large 'drop out' rate – large numbers of students studying at intermediate level one year being reduced to a small number of students sitting their final examinations the following year

Another difficulty was that scholarships were hard to come by for the bright children of parents with limited means and many of these could not devote their full time to study, even as late as 1920 nearly a quarter of students were attending the University on a part time basis The College, and later the University, were faced with other difficulties too, for it was claimed that the upper classes were not attracted to the idea of sending their children to sit beside the sons of tradesmen As for the lower middle classes and the commercial classes, the habit of expecting their children to

TABLE 2

LIVERPOOL UNIVERSITY COLLEGE AND LIVERPOOL UNIVERSITY
GROWTH OF STUDENT NUMBERS
1885 1910

| Year | Number of Students (approx) | | Years | Degrees awarded over five year period | |
|---|---|---|---|---|---|
| | Day Students | Day and Evening Students | | Total number of graduates in science and engineering | Total number of degrees awarded in science and engineering |
| 1885 | 120 | 430 | 1885 89 | 5 | 6 |
| 1890 | 280 | 600 | 1890 94 | 22 | 48 |
| 1895 | 440 | 770 | 1895 99 | 45 | 132 |
| 1900 | 630 | 1 000 | 1900-04 | 60 | 216 |
| 1905 | 750 | 850* | 1905-09 | 73 | 330 |
| 1910 | 900 | 1,200 | 1910 14 | 126 | 505 |

* The fall in student numbers reflects the effect of the new regulations whereby the University was not allowed to conduct pre-matriculation classes

earn money at an early age was very deeply rooted in the district

Although large numbers immediately enrolled at the University College following its formation, the first graduate examination success was not until 1888 and prior to 1890 there were fewer than a dozen such successes In 1893, for instance, over 700 names were registered in the College Address Book, 150 of them studying the sciences or engineering, but there were only three BSc honours degrees awarded that year Nevertheless, despite the large 'drop out' as students progressed through the College, progress during the 1890s both in numbers and quality was rapid (see Table 2) In 1897, thirteen honours BSc degrees were conferred and seven of these (i e 54%) were 'firsts' In 1912 there was an overall 79% pass rate in the degree examinations of the Science and Engineering Faculties Thus, despite the many difficulties and handicaps it had to face, University College succeeded in becoming established in the face of much criticism and by the early 1900s its reputation was secure enough for it to be granted a University Charter

## GROWTH IN STUDENT NUMBERS

A critical factor which held back the advance of education, and in particular of scientific education, was the belief that education should not be free Mr Robert Lowe, Chancellor of the Exchequer, wrote in 1869, 'I hold it as our duty not to spend public money to do that which people can do for themselves ' Mr Lowe was not alone in his views for this attitude was widespread throughout the English educational system and could be seen in the attitudes of both central government and local agencies Public, state or government money should not be demanded when voluntary effort could be expected as a substitute, however inadequate or unreliable this might be

It was essential that fees be charged in all forms of educational establishments, this was just as true at the elementary schools where in fact fees made a negligible contribution to finances, as at the universities

While in some instances, these fees were very moderate they were an effective bar for all but the fairly comfortably off middle classes Particularly was this so for the universities where the fees would have been a formidable obstacle for poorer students The Liverpool Council of Education, formed in 1874, was an innovator in the field of scholarships and began to create a 'ladder' that would carry the bright students by means of scholarships through from the elementary school to the University Its example was

belatedly followed by the City Council, the University, and other voluntary bodies with the result that by 1893 the newly constituted Technical Instruction Committee felt able to claim that it had completed the 'educational ladder' It is to be doubted whether the meagre scheme of scholarships then in being constituted any really effective kind of ladder The bare bones of such a ladder certainly existed but its strength and adequacy may be questioned

The provision of facilities to enable students to sit for degrees was not enough – it was still essential for a student to have some means of support while studying All too frequently this involved a degree of financial hardship for there were too few scholarships available Initially in 1882 only four entrance scholarships were available Muir in 1901 pointed out that a single Oxford College spent £6,000 on scholarships, Liverpool with four times as many students spend only £800 He called for the endowment of further scholarships to complete the 'ladder' from the schools to the university But by 1914 there were still only 35 scholarships, among these were eight Senior City Scholarships founded by the City Council in 1892 and two Senior City Technical Scholarships open to industrial students at the Central Technical School

Between 1882 and 1913, only some 600 students gained entry by means of scholarships of one kind or another That entry to University College by means of scholarships still excluded many bright students in the 1900s is supported by the fact that in 1903 a special fund was reserved for the aid of poor students The money for this fund came from a yearly grant of £1,000 from the Corporation of Liverpool These grants were made in almost all cases to students who failed to secure Senior City Scholarships or the Entrance Scholarships of the University, in some cases they were for the children of parents who earned less than thirty shillings a week The value of this grant may be gauged from the fact that between 1903 and 1913 one hundred and eighty students received help from this fund Of these, 26 gained an honours BSc and 19 a finals BSc, seven an honours BEng and eleven a finals BEng degree

## THE ROLE OF RESEARCH IN AN EARLY CIVIC UNIVERSITY

In view of the predominating importance of research and scholarship in the present concept of the function of a university, it is instructive to review the position of research at the University during its early years

Between 1882 and 1914, the number of staff in science and engineering increased from four to sixty The teaching load in the first two decades was such that opportunity to pursue research was limited, in any case research was not considered to be a requisite function of universities in England at that time

Muir in 1901 had pointed out the difficulties besetting anyone wishing to pursue research

> If a qualified student comes to University College at present and announces that he is prepared to give his time and energy without payment to the pursuit of some scientific investigation he has to be told that he must pay all the cost of the work (5)

An illuminating picture of research in the early days was given by Professor Herdman

> The small groups of enthusiastic young men who formed the first senate of University College, Liverpool, in 1882 were thoroughly imbued with the spirit of research The science men had just come from active centres of original investigation and had brought unfinished work with them Considering how few the workers were during those first years, I believe it was thought elsewhere that the New College at Liverpool was turning out from its lads a goodly number of scientific papers Some of these were published locally and some in the Transactions of the London and Edinburgh societies Oliver Lodge was in those days a tower of strength to us I think we saw more of our colleagues in neighbouring laboratories and knew more of each other's researches than seems possible now Lodge and I, for example, were together in the old Lunatic Asylum, and were nearer geographically than the different floors of the same laboratory may be now (2)

The title given to an article 'Chemical Research in a Modern English University' by Professor F G Donnan suggests that the article shed light on the state of chemical research in British universities and in particular on that at Liverpool Unfortunately Donnan said very little about the extent of research then going on but he did make some very significant observations which are worth noting Donnan argued that British universities were falling short of the true ideas of university learning English universities organised a complex system of lectures, degrees and routine learning In Germany on the other hand, there were no 'pass' or 'honours' systems and no compulsory

lectures

> To everyone is accorded the freedom of learning and of everyone is demanded some addition to the sum of human knowledge In their University system we find what is sadly missing in modern English universities, namely Wissenschaft It is this which constitutes the intellectual strength of Germany (1)

Donnan argued that while chemists need practical laboratory training and also while obviously a high degree of specialisation was required it was essential that the chemist must be taught the history of mankind as well

> The Germans call this Kulturgesichte It embraces the history of religion, philosophy, art and literature and science but our universities have no Chairs of Kulturgesichte (1)

Donnan concluded with some remarks of approval on the German PhD degree with its emphasis on research

At Liverpool it was not until the 1890s, by which time research scholarships had been instituted and departmental staffs expanded, that research began to play a significant role By 1907 there were 25 science research students and five engineering research students In that year 55 research papers were published and these involved 34 names, by 1913 there were 107 papers and 66 names The Calendar of 1914 indicated that, financial criteria apart, encouragement was given to those anxious to pursue research

> Persons desirous of pursuing original research can be admitted, subject to certain regulations, to any of the University laboratories on payment of a fee of £3 per session Applications for admission are determined by the Faculty or upon the recommendation of the Head of Department concerned

Even so, up to 1914 only 99 research scholarships in all had been awarded Twenty-eight fellowships had been awarded in science but none in engineering, a further twenty and eight University Scholarships had been awarded on the results of the honours examinations in science and engineering respectively Prior to 1900, the best opportunity to pursue research was by means of an appointment as assistant to a professor but few such posts were available

One of the outstanding innovations at Liverpool was, of course, the creation of a Department of Biochemistry entirely devoted to postgraduate work and research This came about in 1903 when William Johnston endowed a Chair of Biochemistry and three research fellowships for scientific enquiry in different departments of medicine At first the number of researchers was small but within two years the benches had filled up with workers and by 1906 7, 60 research papers were produced by the department

Professor Moore, the first holder of the Chair, commented in 1911

> There are rarely less than ten research workers in the laboratory at a given time and after the unavoidable expenses of cleaning, gas, light and water there remains to defray the annual cost of materials and chemicals for research an annual sum of about £120 Even when most economical types of work are chosen the average annual expenses of a research worker in a laboratory work out at £20 It follows that for about one third of each year all funds are lacking for the purchase of even the most ordinary materials (4)

Thus even here, the only advanced and specialised centre of research in Liverpool, work was hampered by the same financial limitations that beset other educational institutions in the city The particular limitations on research were highlighted in a comment by Professor Moore

> It is much to be regretted that in the financial systems of our universities no separate provision is made for the endowment of research apart from ordinary undergraduate teaching Even where the Charter of the University insists that it 'shall promote research and shall advance the Arts, Sciences, learning and education' no provision is made for any separate endowment of research The result is a perpetual struggle between teaching and research for the partition of a sum of money inadequate to supply completely the needs of both, and in such a struggle research, though equally or even more important, comes off worst because it is usually regarded by administrators as a luxury, whereas teaching is deemed an essential function in the work of a university (4)

## CONCLUSION

An obsession with clearing the national debt and minimising educational expenditure on the part of central governments meant that the creation and

survival of a new institution of higher learning had to be dependent in the main on its sponsors In this respect Liverpool was an appropriate centre for such an initiative It had amassed great wealth through trade during the eighteenth and early nineteenth centuries It continued to add to its wealth through this source but also through shipbuilding, chemicals and engineering The leading citizens responded to the challenge and were not found wanting with the result that Liverpool University College, by the standards of the day, was comparatively well endowed

Liverpool was fortunate in another respect Because of its variety of industries and commerical undertaking, the city and its surroundings had attracted a galaxy of brilliant entrepreneurs, businessmen and industrialists by the later part of the nineteenth century These included, as well as the Rathbone and Holt families of the shipping world, such men as Sir Henry Tate, Sir John Brunner, William Lever, Ludwig Mond and a host of other continental chemists One leading entrepreneur was James Muspratt credited with being the 'father' of the 'heavy' chemical industry It was his son, Edmund, educated at Heidelberg and Munich where he had first hand experience of German higher education, who became the academic exemplar and guiding hand of the College All these individuals were acutely aware of the international competition and its commercial and industrial effects on shipping, engineering and chemicals on Merseyside Thus whilst University College may have originated from civic pride and a realisation of the educational requirements of the locality, the needs of the national economy and the training of scientific manpower played no small part in motivating its sponsors to continue with their support in face of incessant demands and the apathy of central government

Civic pride at this time was perhaps at its most intense and individuals were asked not only to support the new College but also primary, secondary and technical education as well as the creation of a complex of civic buildings including the museum, art gallery and library Civic pride in Liverpool was put to the maximum test Resources consequently were thinly stretched and despite the desire to give every support it was difficult at times to find the money required Inadequate facilities, gaps in provision and slower growth was the result

When the College began, entry to full time study was limited to those who could afford to pay Part time study was the order of the day It was only with the creation of the College that the full inadequacies of the school system were revealed Not only were the numbers of those coming forward

few indeed but they were inadequately prepared for study at a high level This was particularly the case in science and engineering, for the secondary schools of the country had largely neglected science Thus the College was an appendage to a very inefficient school system Much of the early effort of the College was spent in remedying the deficiencies of its own students The setting and maintenance of a 'university standard' was consequently a problem In time, the position improved with the extension of science teaching in the schools, particularly local authority supported schools, and the creation of a scholarship system enabling the bright pupils from the Council schools to proceed first to 'grammar' school and from there to university

Finally, with time, too, the attitudes prevailing in the College itself changed In the early days the quality of teaching was the thing that mattered, but by 1914 such emphasis was being given to the need for research that it had become the *sine qua non* of a university academic

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