

The 'Gosset' Icterometer: a brief history

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Emeritus Professor Peter Dunn was born in Birmingham, Peter was educated at Marlborough College and Cambridge University (St. John's College). After graduating in medicine in 1954 he served with the Goorkhar Rifles before returning to posts in Birmingham and settling in Bristol ultimately as the Director of the Academic Neonatal Service, University of Bristol. He was appointed to a Personal Chair in Perinatal Medicine and Child Health, University of Bristol, 1987 and attained extensive British and International awards for his work and publications. These numbered more than 400 publications mainly on perinatal medicine including 120 on the history of medicine; contributed to 123 medical reports including preparation of the BPA/RCOG 'Recommendations for the Improvement of Infant Care during the Perinatal Period in the UK' (1978).

Keywords

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ABSTRACT

Dr Isaac Henry Gosset (1907-1965) was the first consultant paediatrician for Northampton, with responsibilities which included both general and neonatal care. In 1954 for neonatal use he designed the 'Gosset Icterometer'. Made of Perspex it allowed a rough estimation of serum bilirubin without requiring a blood test. Two successful clinical trials were published in the *Lancet*, these were amongst the earliest such papers in neonatal care. The 'Gosset' icterometer is no longer used in UK neonatal practice, however sixty years after inventing his device it is still in use in various countries around the world.

THE 'GOSSET' ICTEROMETER: A BRIEF HISTORY

Dr Isaac Henry Gosset (1907-1965) was the first consultant paediatrician for Northampton, his clinical responsibilities included both general child health care and neonatal care^(1,2). Dr Gosset's early training was in Oxford and St. Thomas' London, followed by a brief foray into general practice prior to commencing paediatrics. This was interrupted by World War Two and RAF service. After demobilisation he undertook one year of postgraduate training at Great Ormond Street Hospital, before his consultant appointment to Northampton General Hospital in 1947. There he developed the premature baby unit, which opened shortly after his death in 1965 and which was renamed the 'Gosset Ward' in his memory.

PERINATAL CARE 1950s-1960s

Perinatal care and mortality in the period 1950 to early 1960s was very different to the present. At that time nearly half of all deaths in childhood occurred within three days of birth⁽³⁾. This was an era before the establishment of specific neonatal intensive care units; mechanical ventilation of newborn infants only commenced in 1966 in the United Kingdom (UK)⁽⁴⁾. In Northampton Dr Gosset assisted with the planning of the premature baby unit which opened in 1950, and also in the design of the special care baby unit which opened in 1965. In this he was ahead of his time,

which even in the 1970s saw such units as being confined to teaching centres⁽⁵⁾. The Gosset Ward is currently a Level 2 neonatal intensive care unit, within the Central Newborn Network, UK.

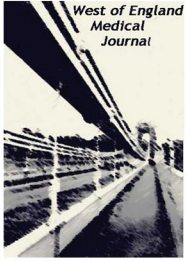
HAEMOLYTIC DISEASE OF THE NEWBORN AND KERNICTERUS

Haemolytic disease of the newborn can be a serious disease characterised by anaemia and jaundice leading to toxic degeneration of nerve cells in the brain or kernicterus. Since the 1950s it was clear that 'replacement transfusion was the best way of preventing kernicterus' due to hyperbilirubinaemia⁽⁶⁾.

Gosset thought a non-invasive test for bilirubin was preferable to subjecting all newborn babies to blood testing for jaundice; many of such blood tests were subsequently seen to have been unnecessary. He devised a scale to estimate bilirubin levels using painted lines of various hues of yellow on plastic strips which became known as an icterometer. One of us (PMD) comments, 'The Gosset icterometer was of tremendous value to me in the 1950s and 1960s when microbilirubin estimations were not available. Venous blood was required. This often meant venepuncture of the femoral or jugular veins or even getting blood from the sagittal suture – all with their attendant complications'⁽⁷⁾.

DEVELOPMENT OF THE 'GOSSET ICTEROMETER'

In March 1954 Gosset devised a scale to estimate bilirubin levels using painted lines of various hues of yellow on plastic strips. Earlier, in February 1954, he had written to paint suppliers Jenson and Nicholson Limited, of London. Their reply enclosed eight strips of yellow colour samples, comprising forty-five different shades of yellow⁽⁸⁾. The principle behind the icterometer was not original. Earlier examples include a tintometer⁽⁹⁾, and a tongue depressor⁽¹⁰⁾, the latter applied with considerable force to 'make visible icterus which was not otherwise apparent'. In a 1958 *New England Journal of Medicine* article on 'early jaundice of the newborn' Allen recommended a polished Lucite stick which can be used to identify early jaundice by blanching the skin⁽¹¹⁾.



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From 1954 to 1957 Gosset handmade his icterometers, however by the autumn of 1957 a local Northampton firm, Modern Fittings, were commissioned to manufacture the icterometer. This company invoiced Gosset for 24 Perspex colour gauges to his specification at a cost of £3 and were probably the only icterometers made by this company. The dimensions of the icterometer are $\frac{1}{8}$ inch thick, $1\frac{1}{4}$ inches wide, 7 inches long (3.18mm, 31.75mm, 177.8mm). The yellow strips are $\frac{3}{16}$ inch wide (4.76mm), as are the gaps between them, and numbered 1-5, 1 being the lightest and 5 the darkest. At this early stage the icterometer had upward curving ends, but the shape of this device made it difficult to carry about. Later models were straight making it more practical and allowing it to be kept in a pocket ready for use. These models, both curved and straight ended, were equally effective when it came to estimating the bilirubin levels. At some point prior to 1960, Thomas A. Ingram and Company, of the Santos Works in Birmingham, was commissioned to manufacture the straight icterometer (figure 1) using the original tins of paint. In a letter of April 29th 1960 the reply was '...sale of this little instrument is going very well, in fact we have supplied five hundred and have two hundred more in hand, for many different parts of the world...' (12).

Throughout this period Dr Gosset was in correspondence with two Birmingham paediatricians, Dr Benjamin Wood and Dr P E Culley (then a research registrar). In 1959 Gosset wrote to Dr Wood that he had retrieved the original five tins and that this '*...should supply enough paint for hundreds of icterometers...*' but that the tins will need '*...pretty vigorous stirring as they have not been used for at least 2 years.*' (13). Dr Gosset sent the paint to Dr Wood; as well as advising the Birmingham team he sent together with the paint a photograph illustrating how the icterometer was to be used. Thus in Northampton and Birmingham

there were two separate concurrent investigations into the efficacy of Gosset's icterometer. (For Birmingham this was during December 1958 to June 1959; for Dr Gosset in Northampton the dates are uncertain, between 1954 and 1959.) Both studies validating the icterometer were published in the same issue of the Lancet, which had included Gosset's own description of his icterometer and its use (14, 15). These two papers are amongst the earliest papers on an intervention within neonatal care. Being published in the Lancet reflected a growing recognition of the importance of perinatal care.



Figure 2
Curved icterometer in use.
(Copyright Peter Dunn)

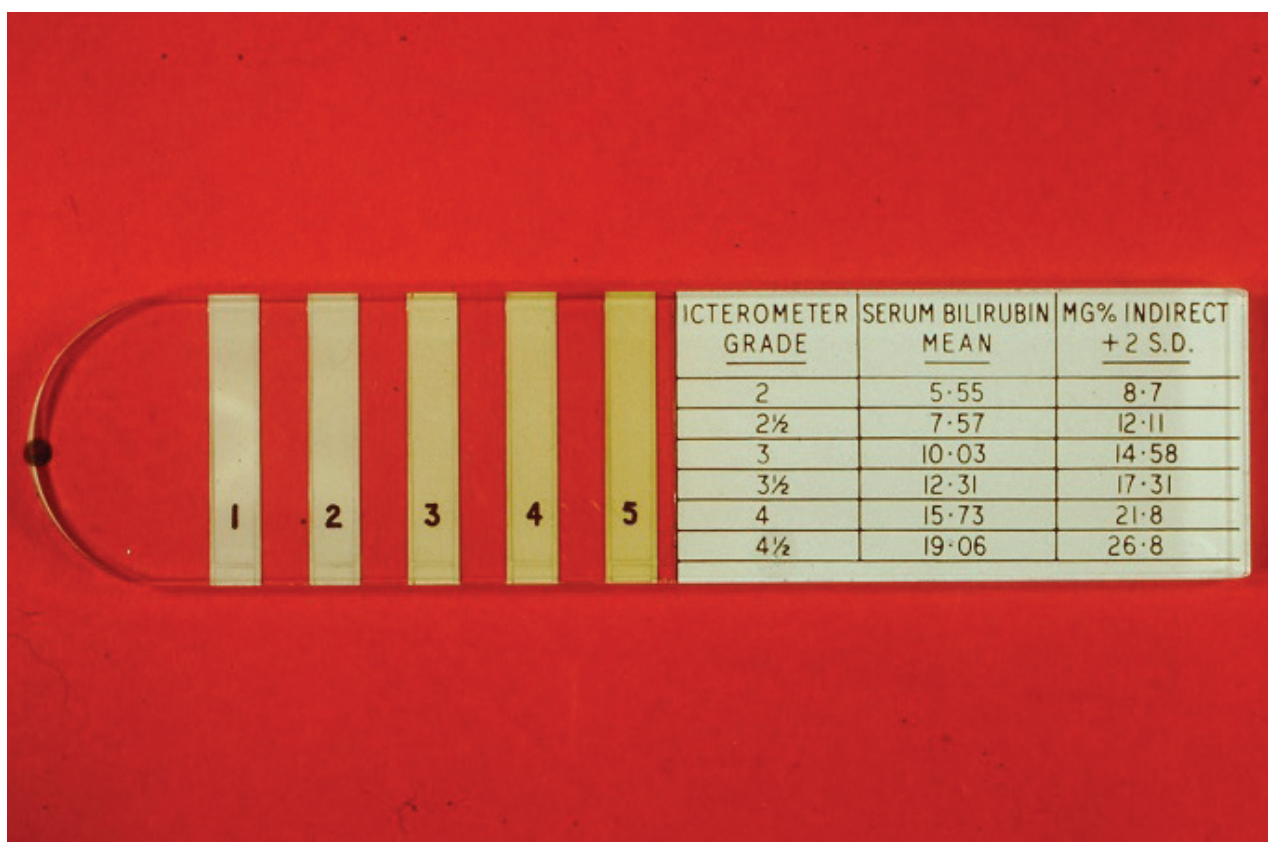
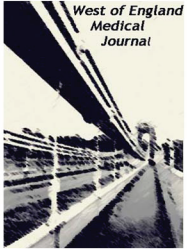


Figure 1, Straight icterometer from Professor Peter Dunn.
(Copyright Andrew Williams)

One of us (PMD) has recorded that he '*...used the icterometer all the time when he was paediatric registrar at the Birmingham Maternity Hospital 1959-1962 and onwards*' (Figure 2 and Table 1)

By January 1961, in spite of some confusion over pricing, over one thousand icterometers had been distributed (16). This pricing confusion stemmed from Gosset's Lancet paper, which stated that icterometers could be obtained for nine shillings and sixpence (£0.48p, equivalent to £9.98p in today's money) each for quantities of a dozen, which many people had misread as nine shillings and sixpence for a dozen icterometers, thus resulting in many enquiries for a free sample to check



DATE	AGE	ICT	BLOOD TAKEN	BILIRUBIN - DIR.
18 th	36hr	2½	-	
19 th	60hr	3½	✓	12 mg% <1
20 th	4 th day	4	✓	16 mg% <1
21 st	5 th day	4	✓	15 mg% <1
22 nd	6 th day	3	-	
23 rd	7 th day	2	-	

Table 1,

Table 1. Jaundice stamp in notes relating age in hours, icterometer reading, whether blood was taken and bilirubin estimations both direct and indirect. (From Professor Dunn's personal collection). Copyright Peter Dunn.

the quality and prices. Correspondence from Ingram's continued until just before Dr Gosset's death in March 1965.

EFFECTIVENESS OF THE ICTEROMETER

In his 1960 Lancet paper, Dr Gosset was candid about the icterometer's limitations in terms of accuracy and inability to differentiate one type of jaundice from another. He was clear that in cases of rapid onset neonatal jaundice (i.e. within thirty-six hours of birth) blood sampling should always be undertaken. It could not be used for babies with bruised noses (in which case gums should be used instead). In children of non-Caucasian ethnicity it will 'merely show whether the jaundice is increasing or not from day to day' and without calibration a blood sample would be required. (However later research published in India in 1991 showed this to be misplaced⁽¹⁷⁾.)

Within these parameters, icterometers were seen at that time as an important advance.

WORLDWIDE CORRESPONDENCE

Dr Gosset's Lancet paper subsequently led to an extensive worldwide correspondence with paediatricians interested in neonatal care at that time. One such correspondence

with Dr Sterling (Chair of the Department of Surgery, at the Albert Einstein Medical Centre in Philadelphia, United States of America), was about the potential role of the icterometer in biliary atresia. Sterling asked can the device be used to, '...identify babies with biliary atresia and differentiate them from other icteric states?', however for this Dr Gosset had not found the icterometer helpful⁽¹⁸⁾.

Gosset had received another communication from the United States of America, this time from a medical instrument supplier based in New York, also enquiring where the icterometer could be obtained. Doubtless this company could see the potential of increased use of the icterometer and were looking to be a supplier of the device in North America.

THE ICTEROMETER'S SUBSEQUENT ROLE AND ITS FALL INTO DISUSE

One of us (PMD) has commented 'Not only was the icterometer an effective clinical tool, equally importantly it saved valuable time when paediatric staffing was minimal. I rate this instrument as the most valuable I had at that time and still is useful today especially for those working outside hospital. I can't think why its use is not approved.'

The accepted mainstream use of the

icterometer was short, up to the early 1970s⁽¹⁹⁾. A highly influential 1962 paper found the icterometer unreliable and then concluded that it should not be used for infants who become severely jaundiced⁽²⁰⁾. We believe this is an unfair criticism as Dr Gosset had made it clear that 'in these circumstances it would be dangerous to rely on the icterometer as a screening test'⁽¹⁴⁾. There was a robust defence from Dr Wood 'It is difficult to imagine a city less endowed with natural daylight than Birmingham (U.K.) during the winter months but perhaps Alberta (Canada) fulfils these conditions. In such circumstances the use of a daylight (or blue lamp) is a real aid.'⁽²¹⁾. However, the momentum for its wider use would appear to have waned and was weakened further by Dr Gosset's unexpected death in 1965.

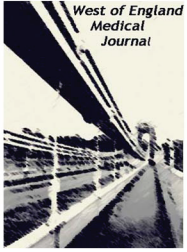
Transcutaneous electronic devices became available from the 1970s and superseded icterometers⁽²²⁾. In mainstream UK neonatal practice icterometers are no longer supported by current NICE guidelines⁽²³⁾.

However the global perspective was somewhat different. In the 21st Century, and sixty years after Dr Gosset invented his device, icterometers are still in use in various countries around the world. They have been found particularly useful for community based carers such as district nurses and midwives. Examples of current icterometer use globally include Vietnam⁽²⁴⁾, Iran⁽²⁵⁾, Nigeria⁽²⁶⁾, Barbados, Germany, United States of America – states such as Massachusetts and Kansas (where in 2013, a midwife from the Kansas Midwives Alliance posted a Facebook request for a replacement icterometer as she had broken hers)⁽²⁷⁾.

Neither Dr Gosset nor icterometers are mentioned in the Wellcome Witness seminar into the origins of neonatal intensive care⁽²⁸⁾. Indeed Dr Gosset's name disappeared from his invention, later papers citing it as the 'Ingram' icterometer after the manufacturer instead, and when citing Gosset's paper attributing it to two authors, Gosset and Oxon, (confusion with his medical degree?)⁽¹⁷⁾.

CONCLUSION

This paper attempts to restore the Gosset icterometer within the history of perinatal care. It was an important advance at that



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time, was in use for several decades, and more than a thousand were made. Gosset's 1960 *Lancet* publication clearly described the icterometer's strengths and limitations. An icterometer, through early recognition of deep jaundice, subsequently confirmed by serum measurement, could prevent permanent significant lifelong neurodisability. Just as importantly it could also remove the need for the newborn to have potentially dangerous and unnecessary blood tests.

ACKNOWLEDGEMENT

We would like to thank the members of Dr Gosset's family who kindly granted access to their family archives for this paper.

The Gosset collection, a repository of Dr Gosset's papers which illuminate general paediatric and premature baby care in the 1950s-1960s, has been placed on the Northampton General Hospital Archive website.²⁹

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