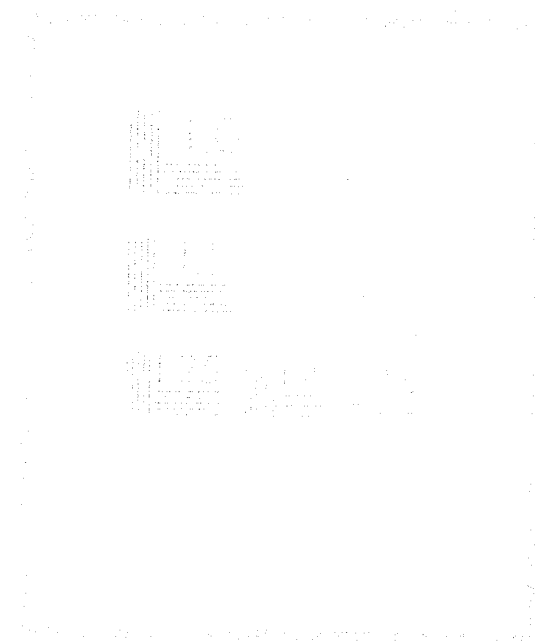


NCJRS

The National Criminal Justice Reference Service (NCJRS) is a national clearinghouse that provides free access to a wide variety of criminal justice information. NCJRS is a part of the U.S. Department of Justice, Office of Justice Programs.

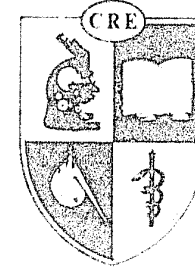


For more information, contact the National Criminal Justice Reference Service at 1-800-848-8760 or visit our website at www.ncjrs.gov.

NCJRS is a part of the U.S. Department of Justice, Office of Justice Programs. It is a national clearinghouse that provides free access to a wide variety of criminal justice information.

U.S. DEPARTMENT OF JUSTICE
LAW ENFORCEMENT ASSISTANCE ADMINISTRATION
NATIONAL CRIMINAL JUSTICE REFERENCE SERVICE
WASHINGTON, D.C. 20531

12/1/84



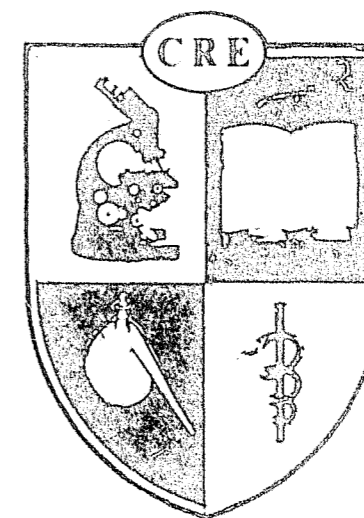
HOME OFFICE CENTRAL RESEARCH ESTABLISHMENT

42124



HOME OFFICE

FORENSIC SCIENCE SERVICE



ANNUAL REPORT OF THE DIRECTOR
OF THE
CENTRAL RESEARCH ESTABLISHMENT

1976

-----oOo-----

HOME OFFICE CENTRAL RESEARCH
ESTABLISHMENT

Director

S. S. Kind

Aldermaston, Reading, Berkshire, England, RG7 4PN.

-----oOo-----



DR A S CURRY

CONTROLLER FORENSIC SCIENCE SERVICE

Director of the Home Office Central Research Establishment from
its inception in 1967 until February 1976

CONTENTS

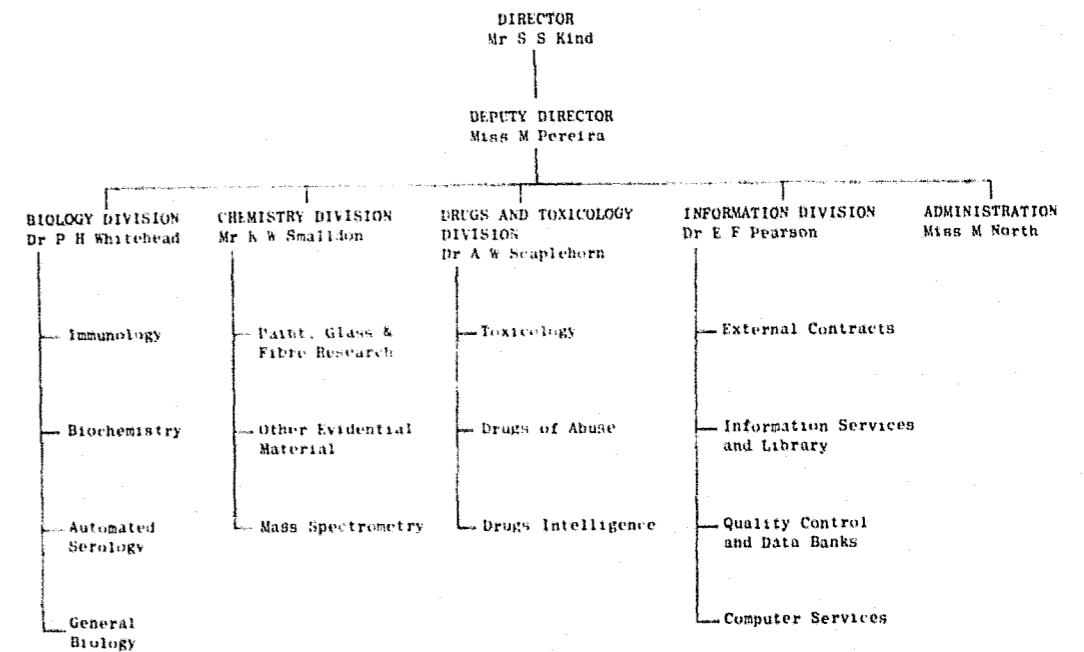
SECTION	PAGE
1 Introduction	1
2 Staff Details	4
3 Lectures and Conferences attended by staff	6
4 Visits and Visitors	11
5 Report of the Biology Division	12
6 Report of the Chemistry Division	22
7 Report of the Drugs and Toxicology Division	38
8 Report of the Information Division	48
APPENDICES	
A List of staff members and staff telephone directory	61
B Current Projects	
Biology Division	64
Chemistry Division	67
Drugs and Toxicology Division	71
Information Division	73
C External Contracts	75
D HOCRE Reports published during 1976	77
E Papers Published in Journals and in press	82
F Colloquia	86
Acknowledgements	90

1 INTRODUCTION

The appointment of Dr A S Curry to the post of Controller of the Forensic Science Service, in succession to Mr E G Davies, completed the first ten years of the life of the Home Office Central Research Establishment. Throughout this time Alan Curry's has been the guiding hand, both in the initial setting-up of the laboratory and in its subsequent development. It is thus inevitable that much of what I have to say in this report, although referring to the first year of my directorship, concerns work conceived and initiated under Alan Curry's management.

It has been a busy year both for me and for my deputy, Margaret Pereira, who was appointed at the same time. We have spent much of our time familiarising ourselves with the work of a well-established research organisation which is widely held to be the best of its kind in the world. During the year we have made only two comparatively major changes in the structure of the laboratory. The first of these changes concerns line management and the second concerns the presentation of CRE research reports and published papers.

As a consequence of the first of these changes the number of separated divisions has been reduced from seven to four. The present management structure is shown below.



This change was viewed with mixed feelings by the staff but, even after this short period, it is apparent that the increase in organisational efficiency more than compensates for the necessary disturbance in making

the change. Obviously, the new system would not work without the support of all the laboratory staff and I am indeed grateful that this has been unstintingly given. Consequent to this re-organisation certain managerial functions of some of the senior staff have been reduced and this has enabled them to concentrate more on the scientific side of their work. This can only be for the good. It is a common occurrence in any scientific field for able research scientists to be weighed down with administrative matters at the expense of their own scientific work.

The second major change which has taken place is in the presentation of the research results of the Establishment to the operational laboratories of the Home Office Forensic Science Service. This has been conditioned by the view that it is far better to spend extra time at the production stage on editorial and presentation matters, than to present the overworked operational scientist with material which may be of either unfathomable prolixity or uncertain scientific sense. We all believe that we can write in our native language and it is only natural to assume that lack of comprehension is a fault of the reader rather than of the author. Thus the reports of CRE now approximate rather more to that which normally appears on the printed page of a scientific journal than to the double-spaced manuscript which the Editor receives.

The already established practice of CRE personnel demonstrating new techniques is to be extended by the adoption of the attitude that the research forensic scientist should attempt to present to his operational counterpart a fully researched and developed method, which requires nothing further on the latter's part other than the absorption of the given information followed by his own experimental assessment of the method.

It would be difficult to single out those subjects likely to be of most value to the operational forensic scientist but, if I were asked for those areas of work in progress at the Central Research Establishment which I feel to be most promising, I would mention the following topics.

An automated machine constructed under one of our Contracts, has effectively removed the tedium in the dilution stage of the analysis of blood samples taken from people suspected of driving with blood alcohol concentrations above the legal limit, (see page 53). All operational laboratories are now being equipped with these machines.

The provision of scientific and technical information to scientists in the operational laboratories has grown rapidly in the last year; monthly figures showing a 20% increase over similar periods in 1975. A feature of this growth has been the increase in the number of enquiries concerning information on motor vehicles, (see page 49).

Automatic quantitative analysis of ABO blood-group substances in body secretions is giving a greater understanding of the properties of these substances, which will lead to improved methods of grouping semen stains in sexual offences, (see page 15).

Antibody profiling has extended the information obtainable from blood stains beyond that which can be obtained by normal blood-grouping. It has been shown how the allergy status of an individual may be derived from a bloodstain and how this may, in turn, give information relating to his country of origin. An external contract with Glasgow University may give much greater detail of a person's medical history through a study of bloodstains for antibodies to viral diseases, (see pages 18 & 50).

The use of X-ray fluorescence spectrometry has proved of considerable value in the discrimination of paint flakes and other trace materials. This technique has already been used successfully in casework on several occasions, (see page 28).

Considerable progress has been made in the development of methods for the detection of explosives residues, with the development of a simple but effective kit for taking samples from a suspect, (see page 33).

A major advance in the analysis of drugs has been the use of the proteolytic enzyme *subtilisin* to digest tissues prior to extraction. The use of this method has resulted in a dramatic increase in the amounts of drugs recovered from such tissues, (see page 43). The development of an assay for LSD based on radioimmunoassay and High Performance Liquid Chromatography with fluorimetric detection has been completed and is now used on casework material.

I speak for both my Deputy, Margaret Pereira and myself, when I extend my thanks to all our staff for their hard work, patience and forebearing attitude during this first year of our appointments. The brunt of the work has fallen on our four Divisional Heads, Dr E F Pearson, Dr A W Scaplehorn, Mr K W Smalldon and Dr P H Whitehead. The year has been sufficient to dispel for us any lingering doubts we held on the value of the Senior Professional Administrative Training Scheme (SPATS). Those two Divisional Heads who have been on the course have proved invaluable in the setting up of new administration systems and, I am sure, in the educational effect which they have had upon the rest of us who are not SPATS trainees.

It may perhaps be invidious to single out the name of an individual for comment when such ungrudging support has been given by all members of the Senior Managing Staff, but I cannot let this occasion pass without mentioning the most difficult and complicated task undertaken by Dr E F Pearson, Head of the Information Division. It is within this Division that the major organisational changes have caused the greatest amount of extra work. This, together with the fact that the Information Division is the most heterogenous and possibly, the most managerially demanding, has placed loads on Dr Pearson which he has met with unfailing good humour and competence.

I wish to thank all the directors of the operational laboratories for their support. I also extend thanks to our two consultants, Professor T Mann CBE ScD FRS of the ARC Unit of Reproductive Physiology and Biochemistry at Cambridge and Dr F Rose OBE FRS, consultant to the Pharmaceutical Division of ICI at Alderley Edge for their advice and assistance. Finally I thank Alan Curry for leaving me such an excellent organisation to manage and for being the source of unstinting help throughout the year.

2 STAFF DETAILS

We welcome:

Mr D R Boase (ASO) from ICL
Mrs J Gomersall (CA) from AWRE
Mr W F Hillen (Driver) from a local dairy
Mr S S Kind (Director) from the Newcastle Forensic Science Laboratory
Dr E F Pearson (PSO) on his return from the Senior Professional Administrative Training Scheme
Miss M Pereira (Deputy Director) from the Metropolitan Police Laboratory
Mrs R Wigmore (SO) from the Cardiff Forensic Science Laboratory

Departures:

Dr P E Burdett, transferred to the Cardiff Forensic Science Laboratory
Dr A S Curry (Director) to become Controller, Forensic Science Service
Dr A E Kipps, resigned, emigrated to Germany
Mrs D Morgans, to have a baby
Miss V E Quarmby, to take up a research appointment to the Imperial Cancer Research Fund
Mr G W Walker (Deputy Director) to become Director, Aldermaston Forensic Science Laboratory

Congratulations to:

Mr D S Loxley on his marriage to Janet Aust
Mr P Owen on his marriage to Sheila Carlisle
Mr B Platt on his marriage to Jeannette Hamm
Mr J Porter on his marriage to Deborah Rex

We record the attachment of the following sandwich course students:

Mr C P Offen from the Lanchester Polytechnic
Miss A E Pendlebury from the University of Surrey
Mr D Richards from the Trent Polytechnic
Mr A D Sedgwick from the North East London Polytechnic
Miss N Vasir from the Hatfield Polytechnic

Retirements:

Mr W Marsh-Gabb (Laboratory Attendant) who joined CRE in 1974 and retired in November
Mr L Rowbottom (Driver) who joined CRE in 1967 and retired in February

Promotions:

Dr R E Ardrey to SSO
Mr D S Loxley to SSO
Mr C Howden to HSO
Mr I J Humphreys to HSO

Individual Merit Promotions:

Dr H M Stevens to SPSO
Dr P H Whitehead to SPSO

New Appointments and Qualifications

Dr Jean Twibell was appointed SRF in the Biology Division
Dr A Allan obtained his PhD from the University of Newcastle Upon Tyne
Miss T Holdstock obtained 'A' level Pure Mathematics
Dr R Holleyhead obtained 'A' level English Literature
Dr P Owen obtained his PhD from the University of Surrey
Dr R Macrae was awarded an MA by Oxford University

Registration for Higher Degrees:

Mrs M J Dorrill for MSc at the Brunel University
Mr C R Howden for MSc at the University of Strathclyde

Staff Attachments:

In the course of the year the following members of CRE staff spent one-week periods of attachment to operational forensic science laboratories:

Dr A Allan (Newcastle)	Dr D Osselton (Harrogate)
Dr S Fletcher (Chorley)	Mr J Porter (Nottingham)
Miss T Holdstock (Birmingham)	Miss V Quarmby (Chorley)
Mr C Howden (Cardiff)	Dr J Twibell (Harrogate)
Dr J Locke (Bristol)	Dr D Werrett (Newcastle)

In January, representatives of each operational laboratory spent a one-week period of attachment to CRE.

In September, Dr M Klein of the Drugs Enforcement Agency, USA, spent a one-month period of attachment to the Drugs Intelligence Unit.

In October, Dr L R Mullings, from the Western Australian Institute of Technology, joined CRE for a 12-month period of attachment.

3 LECTURES GIVEN AND CONFERENCES ATTENDED BY STAFF

LECTURES:

S Fletcher	"Detection of LSD and its Metabolites"	International TIAFT meeting, Ghent
	"Radioimmunoassay of LSD and its Metabolites"	University of Surrey
P J Gomm	"The Functions of the Drugs Intelligence Laboratory"	Police Liaison Officers' Seminar, CDIIIU, London
	"Illicit Drug Laboratories"	Stirling Police HQ, Scotland
	"Precursor Materials"	Home Office Drugs Branch, London
S S Kind	"History and Functions of the Forensic Science Service"	Police Academy, Wakefield
L A King	"Allergy Profiles from Blood-stains: Clinical and Forensic Aspects"	2nd Charles Blackley Symposium on Clinical Aspects of Allergic Disease, Nottingham University
J Locke	"Mass Spectrometry in Crime Detection"	The Institute of Physics
A C Moffat	"Drugs and Forensic Science"	Hertfordshire Constabulary
	"Drugs: their Identification and Classification"	Police College, Bramshill
	"Current Trends in Toxicology"	University of Birmingham
	"Absorption of Drugs"	Chelsea College
	"GC Methods for the Analysis of Drugs"	Loughborough University
M Pereira	"The Art of Tracemanship"	Post Graduate Medical Centre, Basingstoke
	"Practical Aspects of Serology"	Association of Police Surgeons

K W Smalldon	"Forensic Chemistry"	University of Surrey
J Sutton	"Optimal conditions for the Assay of Human Seminal Plasma Phosphoglucomutase"	ARC Unit of Reproductive Physiology and Biochemistry, Cambridge
	"A Kinetic Study of Human Seminal Plasma Phosphoglucomutase"	Department of Biochemistry and Physiology, Reading University
P Twitchett	"Evaluation of HPLC Columns for drug and metabolite analysis"	Kings College Hospital
D J Werrett	"A Computer Evaluation of the RAST test"	2nd Charles Blackley Symposium on Clinical Aspects of Allergic Disease, Nottingham University
P H Whitehead	"Forensic Biology"	Senior Police Officers' Course, Scottish Police College
	"New Developments in Forensic Biology"	Meetings of the Association of Chief Police Officers at Hutton and Derby
CONFERENCES:		
R E Ardrey	Chemical Society Residential School on Mass Spectrometry	University College of Swansea
	Mass Spectrometry Discussion Group Meeting	Finnigan Instruments, Hemel Hempstead
	IUPAC International Symposium on "Techniques for the Retrieval of Chemical Information"	Royal Society, London
C Brown and M Swain	Royal Society Information Meeting (IUPAC)	London
M Davie	Biotest Symposium on "Problems in Pre-Transfusion Tests"	Birmingham University
Mrs M Dorrill	Amicon Ultrafiltration seminar	High Wycombe, Bucks
R J Dudley	X-Ray Spectrometry Summer School	Kings College, Cambridge

	Symposium on "Microscopy in Forensic Science"	School of Pharmacy, London
B German	Seminar on "Plasma Emission Spectroscopy"	Techmation Ltd
B German and R Macrae	Symposium on "Non-Flame Atomic Absorption by Electrothermal Atomisation"	Chemical Society, University of Bristol
M Harold	AWRE Apprentices Exhibition	AWRE Aldermaston
C R Howden and R Macrae	Chemical Society discussion on "Flameless Techniques: Can they give the right answer?"	Imperial College,
	5th Annual Perkin Elmer Atomic Absorption Spectrophotometry Conference	Royal Zoological Society Meeting Rooms, London
S S Kind	Spring Symposium on "The Historical Development of the Forensic Sciences"	Forensic Science Society, Birmingham
	"Fraud, Forgery and False Pretences"	Forensic Science Society Symposium, Metropolitan Police School, Hendon
J Locke	"Different Sources for Mass Spectrometry"	Special Techniques Group, Analytical Division, Chemical Society
A C Moffat and P Owen	"Cyclic Nucleotides as Targets in Drug Research"	Chelsea College
E Osselton	"The Use of Enzymes in Analytical Chemistry"	Chemical Society, London
Miss M Pereira	Symposium on "Value for Money"	Chemical Society Leeds
	Biotest Symposium on "Problems in Pre-Transfusion Tests"	Birmingham University
A Sullivan	Meeting of British Pharmacological Society	Royal College of Surgeons, London
J Sutton	Iso-electric Focusing Display Exhibition	Chemical Society, London

M Swain	"PRECIS" Cataloguing system Dialtech Seminar UKCIS Forum	British Library London
Dr Jean Twibell	Royal Microscopical Society Lecture on "Microscopy in Forensic Science"	School of Pharmacy, London
P Twitchett	"HPLC in Clinical Chemistry"	Kings College Hospital, London
D J Werrett	British Society Workshop on "Allergy and Clinical Immunology"	Oxford University
P Williams	"Drug Metabolism"	University of Surrey

ACPO Conference - Hutton, Lancashire 14-17/3/76

The Association of Chief Police Officers (ACPO) routinely holds a series of conferences each year usually at different county police headquarters. A new feature of its meeting held this year at the Lancashire Police HQ in Hutton in September was a series of lectures and an exhibition organised by the Home Office Police Technical Services under Mr R A James. The aim of the demonstration was to bring to the attention of senior police officers new scientific aids being introduced to assist the investigation of crime as a result of research in the Police Scientific Development Branch (PSDB) and the Forensic Science Service (FSS). Staff from both HOCRE and the HOFSL Chorley were involved in the forensic science section of the demonstration.

The lectures took the form of short talks given by individual specialists from PSDB and FSS, which were linked by a narrator and presented as a story of a kidnapping. Each talk was illustrated with slides and each scientific technique was related to police operations taking place during the "kidnapping". An exhibition followed the lectures illustrating recent advances in forensic science and police technology. The forensic science part of the exhibition included the identification of vehicles from car paint and headlamp identification using computer retrieval, soil particle analysis using a Coulter Counter, new markers in blood, and thin-layer chromatography of fibre dyestuffs.

Following a successful demonstration in Hutton, a second performance was organised on request at an ACPO meeting at the Derbyshire Police HQ in October.

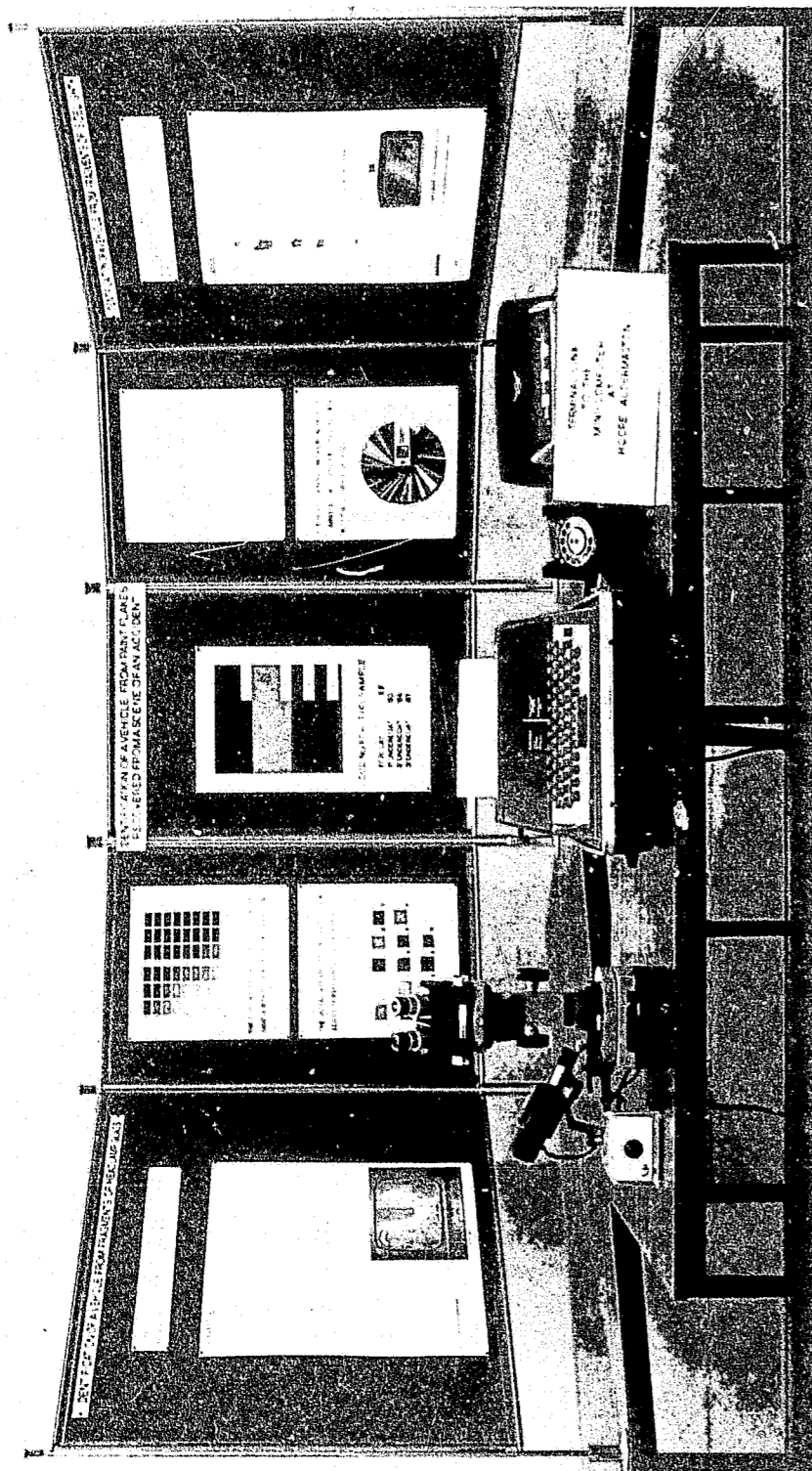


Figure 1: This display was used at the ACPO meeting to illustrate the vehicle identification service which the Central Research Establishment provides

4 VISITS AND VISITORS

VISITS:

During the course of the year Mr S S Kind visited the Forensic Science Laboratories at Belfast, Bristol, Cardiff, Chorley and Newcastle.

Visits abroad were made by:

Mr S S Kind to lecture and chair a Round Table Discussion at the Laboratoire Interrégional de Police Scientifique at Lyon;

Dr L A King to discuss with the Bundeskriminalamt, Wiesbaden, problems relating to the sexing of human bloodstains;

Dr A C Moffat to attend the 5th European Workshop on Drug Metabolism at Stockholm.

VISITORS:

Visitors to CRE in 1976 included the following:

- Dr K A Brown, Forensic Odontologist, Adelaide
- Mr R K Brown, Mr G Twist - HM Inspectorate of Constabulary
- Mr J Challinor, Government Chemical Laboratories, Perth
- Mr B Collins, Australian Mineral Development Laboratory, Adelaide
- Mr C S Crisp, Government Department of Chemistry, Adelaide
- Dr B N Dailly, Government Laboratory, Hong Kong
- Herr Dr W Deinert, Herr Dr E M Müller - Bundeskriminalamt, Wiesbaden
- Colonel W Dixon, Major G L Jones, Capt M A Thomson, Major R Wright - USAF
- Commander Duffy (Metropolitan Police), Det Insp Perry, Mr M J Isaacs (Aldermaston Forensic Science Laboratory), Dr Price (Metropolitan Police Laboratory), Mr D Gordon Thomas (Police Scientific Development Branch); Scenes of Crime Team
- Professor D J Gee, Mr S Gelder - University of Leeds
- Dr M Hall, Commonwealth Police, Australia
- Herr K Hellwig, Professor Dr E Konecny, Dr P Naumann, Dr M Schinkmann - Dragerwerk, Lubeck; Mr R Horne, Mr A G Mortimer - Drager Safety
- Dr B H Horton, Australian Forensic Science Society, Adelaide
- Dr Hoveling, Melbourne Institute of Technology
- Mr F Hurst, Department of Scientific and Industrial Research, Petone, New Zealand
- Dr S Kraus, Israel Police Headquarters, Jerusalem
- Dr Krishnawamy, Commissioner of Police, Madras
- Herr Dr C Leszczynski - Bundeskriminalamt, Wiesbaden
- Professor T Mann, ARC Unit of Reproductive Physiology and Biochemistry, Cambridge
- Professor J Matthyer, Lausanne Institute of Police Science, Switzerland
- Dr Poudayle, Public Health Laboratory, Nepal
- Dr F Rose, ICI, Cheshire
- Dr E E Storey, Health Commissioner, Sydney
- Dr M Tassa, Division of Criminal Identification, Jerusalem
- Dr Brita Teige, Institute of Forensic Medicine, Oslo
- Professor J H Turnbull, Royal Military College of Science, Shrivenham
- Miss J Watson, Bureau of Customs, Sydney
- Mr S Zitrin, Israel Police Headquarters, Jerusalem

INTRODUCTION

As in previous years a major part of the work of the Biology Division has been directed towards investigating problems associated with the grouping of body fluids other than blood. New techniques for typing semen stains based on the presence of the immunoglobulin genetic markers Gm and Km have been established. An improved method for the PGM typing of semen has been developed and the automatic quantitative analysis of ABH blood-group substances in saliva and semen is now allowing the investigation of questions raised over the years relating to the grouping of secretion stains. For example: (a) do some individuals secrete ABH substance in one fluid and not in another?, (b) what is meant by a 'weak secretor'?, (c) how much credence should be given to reports of polymorphism of ABH substances in saliva and semen?.

In contrast to these fundamental studies on secretions an evaluation has been made of the techniques available for the electrophoretic characterisation of seminal acid phosphatase.

Work carried out on blood over the past year has ranged from establishing further the new concept of 'antibody profiling' by means of 'blind' trials to the practical task of evaluating reagents and antisera for the initial screening and species identification of blood.

The research work initiated last year on the protein chemistry of hair has followed two main lines of enquiry.

- (a) The electrophoretic analysis of hair keratin
- (b) The investigation of the properties of hair sheath cells, especially their enzyme constituents

The electrophoresis of keratins has proved disappointing for discriminating between hairs of the same species but a number of enzymes, including phosphoglucomutase (PGM), have been identified in sheath cells which has allowed the PGM phenotyping of freshly plucked hairs.

The Division has also been actively involved in the organisation of a "teach-in" on Gm and Km typing, the supervision in co-operation with Information Division of a number of external contracts and the distribution of anti-species latex reagents to operational laboratories.

SEMEN AND SALIVA

Immunoglobulin markers

The immunoglobulin genetic variants Km(1) and Gm(1) were discovered in liquid semen and saliva last year (HOCRE Report 155) and since that time further Gm markers (1, 2, 3, 5, 10 and 14) in semen have been identified (HOCRE Report 198). However, not all of these markers are readily typed in semen stains and Km(1), Gm(1) and (2) are now being used. The reliability of this system is being investigated with a trial involving the operational laboratories. Paired blood and semen

stains from the laboratories are being typed 'blind' by HOCRE and the Metropolitan Police Forensic Science Laboratory (MPFSL). On the basis of the results of this trial it should be possible to make recommendations as to the use of this new and potentially very valuable means of typing semen. (Figure 2). It should be noted that making use of just the three

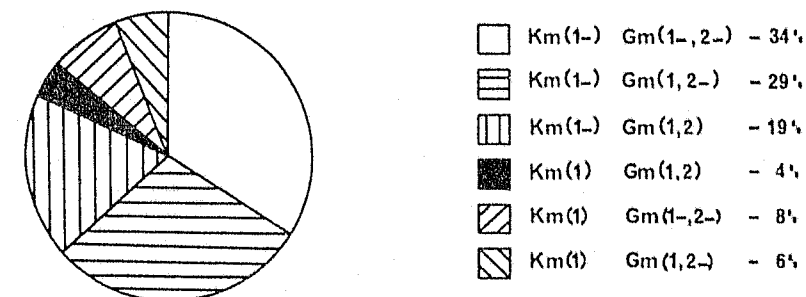


Figure 2: Distribution of Immunoglobulin Phenotypes in the British Population

listed above, the ability to discriminate between two semen samples taken at random is similar to that achieved by the Rhesus system on blood.

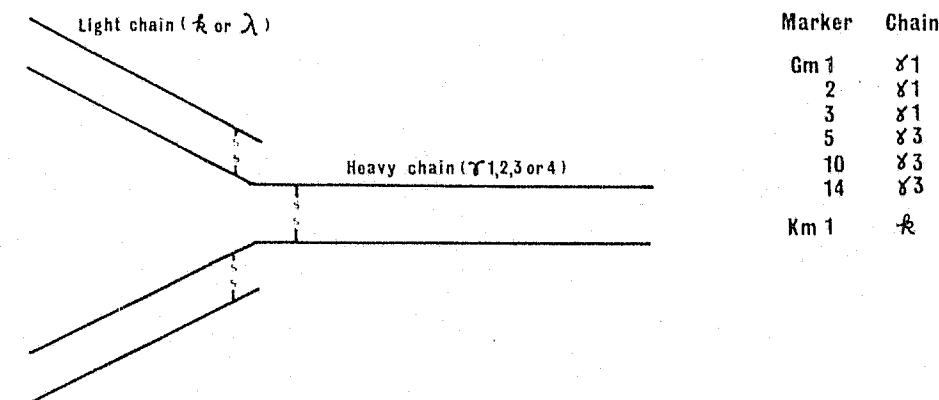


Figure 3: Immunoglobulin Structure and genetic markers

Phosphorylase

The PGM phenotyping of semen stains is widely practised in the United Kingdom and following basic studies on the kinetics of this enzyme in semen (HOORE Report 179) a new overlay system for detecting PGM using enhanced following electrophoresis has been described (HOORE Report 203). The new method is approximately twice as sensitive as traditional detection methods (Figure 4) and allows for the inhibiting effect on PGM of deionised water in high coverage in semen.

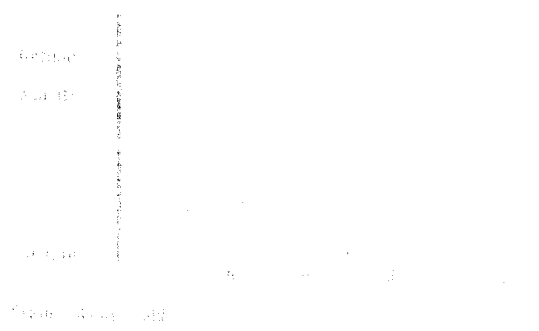


Figure 4: Comparison of the starch gel electrophoretic patterns of a 100% semen stain typed by the traditional method and new overlay system (deionised water represent 100 bands)

The new overlay system has been successfully used to study the new PGM control required by the Home Office Forensic Science Laboratory. The new PGM control is shown very clearly in the new groups contained

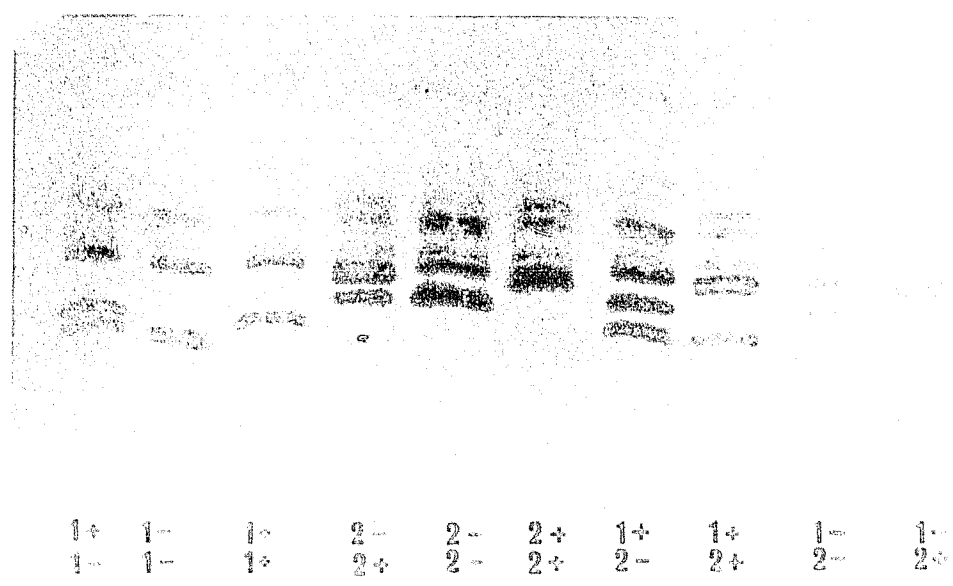


Figure 5: Isoelectric focusing (pH 5-7) of red-cell PGM

by isoelectric focusing where formerly only three were obtainable by conventional starch-gel electrophoresis. The application of the new PGM system together with the immunoglobulin markers for grouping semen will lead to a great improvement in the biologist's ability to investigate male sexual offences.

While progress is being made in introducing new techniques for the examination of semen, problems associated with the widely used grouping methods based on the ABH system are being investigated. The capacity to assay to within 10% experimental error ABH blood group substances (BGS) in saliva and semen using an AutoAnalyzer (Figure 6) has allowed a quantitative study to be made of the effect of boiling on BGS in saliva (HOORE Report 195).

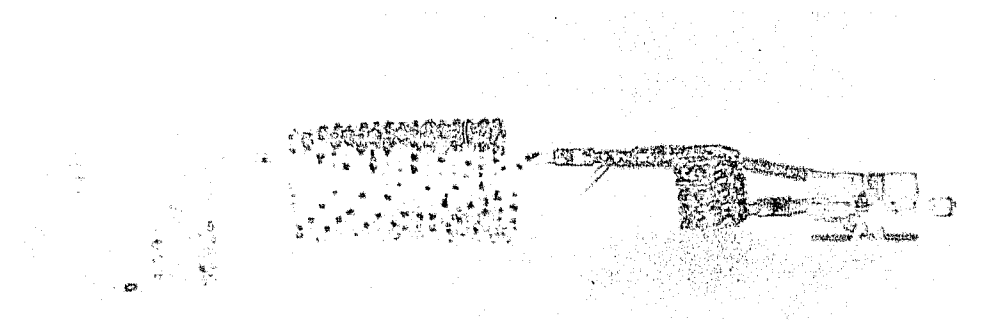


Figure 6: The agglutination of red cells in the reaction coil of the AutoAnalyzer used for the automatic ABG grouping of saliva

This is a necessary pre-requisite to further studies on saliva either in the research or operational laboratory due to the lability of BGS in this fluid. No significant change in the levels of A, B or H substances, nor any anomalous activity, was found on boiling (Figure 7) and so we would advocate the boiling of all samples of liquid saliva on collection. (HOORE Report 199). However, as this is frequently an inconvenient task for the police officer we are studying other means of stabilising ABH substances in saliva.

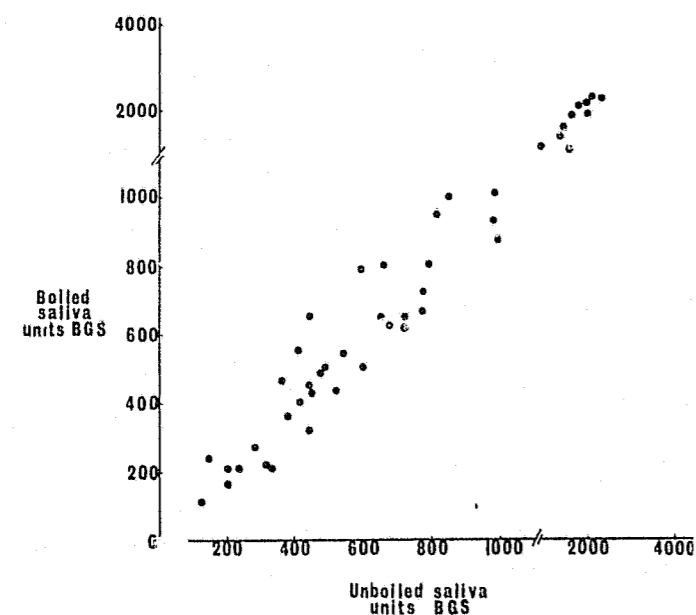


Figure 7: The effect of boiling on A blood group activity in saliva (similar results were obtained with B and O secretors). The units of BGS are as in Table 1

Studies on the concentrations of A, B and H substances in saliva and semen from many individuals are now being made on the AutoAnalyzer. Although the programme is still in its early stages (the availability of samples being the major limiting factor in any study of this nature) we have confirmed the very much higher levels of ABH substances in semen compared with saliva (Table 1). In addition we have identified a very wide spectrum of "secretors" in saliva and have been intrigued by the major difference in A/H and B/H ratios observed in semen as compared with saliva (Table 2). The next stage of the programme to correlate levels of ABH substance found in semen and saliva from one individual is expected to prove even more interesting.

The polymorphic forms of ABH substances in semen and saliva reported by Professor Fiori and his colleagues over the past few years continue to prove elusive. Despite careful attention to this matter we have been unable to confirm the Italian group's findings. However, with the kind collaboration of Professor Fiori, we look forward to resolving the issue in the not too-distant future. Samples of saliva and antisera have been received from Professor Fiori and we are now examining them.

TABLE 1

THE CONCENTRATION OF ABH SUBSTANCES IN SEMEN AND SALIVA

Units of Blood Group Substance				
BGS	Body Fluid	Mean	Range	Number of Samples
H	Saliva	1262	38- 4300	262
	Semen	18000	45-82000	30
A	Saliva	1509	325- 9900	221
	H	903	100- 4800	
A	Semen	3435	150- 9500	17
		16275	8500-44000	
B	Saliva	1685	133- 3750	66
		344	125- 770	
B	Semen	4850	1050-13500	6
		30312	11250-52000	

TABLE 2

RANGE OF A:H AND B:H RATIOS IN SALIVA AND SEMEN

Ratio	Saliva	Semen
A:H	0.14-35.4	0.009-4.20
B:H	0.13-14.8	0.040-3.46

The blood group substance units used in tables 1 and 2 are related to a pooled freeze-dried saliva standard allotted arbitrary units for A, B and H activity as follows: H, 512 units/ml; A, and B 256 units/ml. (HOCRE Report 185).

Mixed blood and body secretion stains

The grouping of semen or saliva stains alone can prove troublesome to the biologist but when these stains are mixed either together or with blood and/or vaginal secretion, the problems are magnified. A comparison has been made of three techniques advocated for separating seminal from vaginal acid phosphatase. The techniques studied were electroimmunodiffusion (EID) isoelectric focussing (IEF) and polyacrylamide electrophoresis (PAGE). None of the three techniques proved satisfactory for all of the vaginal swabs examined (130) but the EID technique has the advantages of being cheap, rapid and requiring no special apparatus. Its disadvantage lies in a slight anodal movement of vaginal acid phosphatase which may be misleading if due allowance is not made.

The hazards that mixed blood/saliva or blood/semen stains present in case work are documented in a recent report of work carried out jointly with the Chorley Forensic Science Laboratory (HOCRE Report 191). The report also demonstrates how easily the presence of saliva in a "blood stain" may be detected using the amylase-sensitive test-paper reported earlier (HOCRE Report 178).

BLOOD

Research work on blood has been concentrated in two widely different areas. One is the further development of antibody profiling and the other is the evaluation of reagents and antisera for identifying blood.

Antibody profiling

A feature of present blood-grouping methods in forensic science is the necessity of having blood from both victim and suspect to compare the groups. Such a comparative approach is a feature of many forensic science investigations. However, antibody profiling offers the possibility of deriving information from a bloodstain in the absence of a "control" blood, relating to age, race and past health record of the donor. Earlier work described how the identification of antibodies to *Mycobacterium tuberculosis* in a bloodstain indicates that the stain originates from an adult as distinct from a child. (HOCRE Report 154).

The concept has been further extended to identifying IgE antibodies in bloodstains. IgE antibodies are those produced in the host against allergens and identification of these in a bloodstain gives information concerning the susceptibility of the blood donor to various allergies (HOCRE Report 181). In a study of the levels of IgE antibodies found in bloodstains submitted from laboratories both in the United Kingdom and North America, it has been shown how blood from North American residents may be differentiated from blood from British residents (HOCRE Report 197). The basis of this discrimination lies in the observation that hay-fever sufferers in the UK are usually sensitive to grass pollens whereas sufferers in the Americas are sensitive to ragweed.

Further variation across the United States has been observed from a study of ragweed antibodies in blood, as a higher percentage of the population in the Eastern states of the USA are sensitive to ragweed pollen than in the West. (Figure 8).

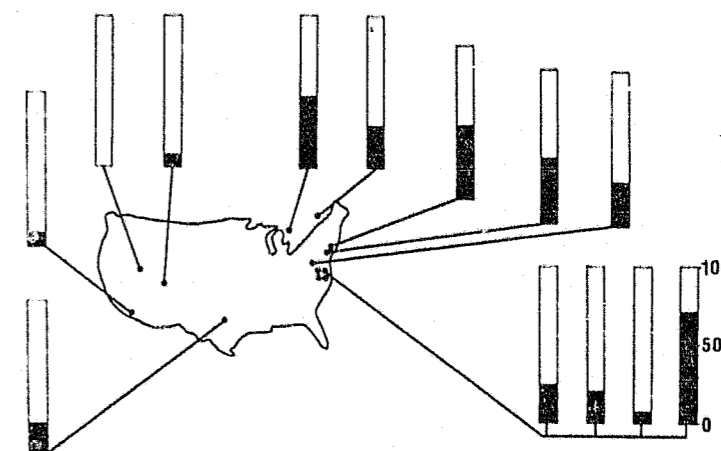


Figure 8: Location of the 13 North American mainland laboratories participating in the Ragweed survey. Solid bars show the incidence of positive diagnoses in each case

At present antibodies to a range of micro-organisms and allergens have been identified in bloodstains (see publications list). The next stage will be identification of antibodies against viruses including measles, influenza, mumps and polio. This is the subject of a contract with Glasgow University. The full potential of the antibody profiling approach to bloodstain discrimination has yet to be realised and operational trials with case-work material are being carried out.

Presumptive tests for blood

In contrast to the above long term work, an evaluation has been made of reagents for the presumptive testing of blood. An awareness of the carcinogenic nature of some of the reagents used by the forensic biologist prompted the development of new reagents for blood screening, especially 3,5,3',5'-tetra-methyl benzidine (TMB). However, this reagent proved expensive and the much cheaper reagent Leucomalachite Green (LMG) has been found to be equally satisfactory for both presumptive testing of blood and haptoglobin typing. (HOCRE Reports 180, 201).

Problems sometimes come in the species identification of blood, and the Biology Division has over the years evaluated commercial reagents for this purpose. The latest study was an evaluation of a German company's products which were found to be satisfactory (HOCRE Report 187).

HAIR

Protein electrophoresis

Discrimination of human head hairs still remains a problem for the forensic biologist. Reports of a genetic variation in the protein bands

observed by polyacrylamide gel electrophoresis following solubilisation of hair keratin prompted work at HOCRE in this direction. We have been unable to confirm this work and in our hands such electrophoresis appears to be suitable only for discriminating hair from different animal species but not between individuals of the same or closely related species.

Hair Sheath Cells

Studies of sheath cells associated with hair roots may prove more profitable. Simple microscopic examination of sheath cells has shown how the presence, or absence, of sheath cells may be more a reflection of the individual than the mode of removal of the hair from the scalp i.e. whether plucked or naturally shed. A certain amount of discrimination between individuals is possible since the percentage of anagen hairs with sheath cells in samples from one person tends to be fairly constant (HOCRE Report 171). Subsequent work has confirmed these early observations.

Sheath cells, in common with other living tissue, contain a range of enzymes associated with the glycolytic pathway and enzymes such as α -galactosidase have been assayed for clinical purposes. In view of this, a search was made for the enzymes commonly used in forensic serology. Erythrocyte acid phosphatase (EAP), PGM, esterase D (EsD), adenosine deaminase (ADA) and adenylate kinase (AK) were detected. However, such was the quantity of PGM present that it proved possible to phenotype a single plucked hair by traditional starch-gel techniques. (Figure 9). However, it has not yet been possible to type naturally shed hairs and efforts are continuing in this direction.

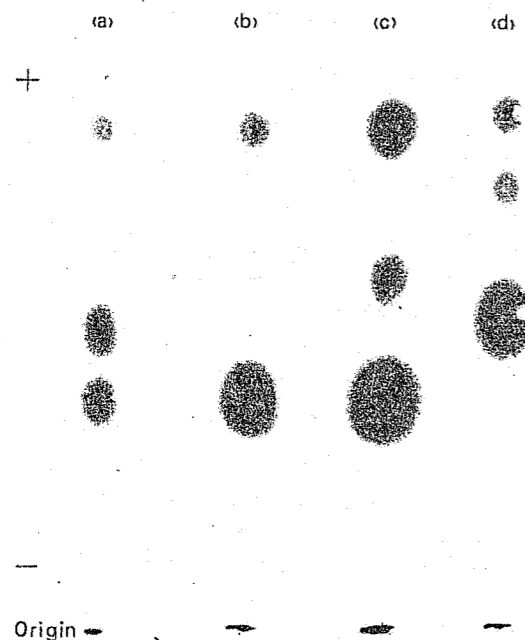


Figure 9: Starch gel electrophoresis of PGM from single plucked hair roots. (a) PGM 2-1, (b) and (c) PGM 1, (d) PGM 2

NEW AREAS OF RESEARCH

New areas of research work initiated over the past year include:

- (a) a study of vaginal constituents on swabs taken following sexual intercourse with a view to determining time elapsed since coition.
- (b) an investigation into the potential use of the enzyme-linked immuno-sorbent assay (ELISA) in forensic serology.
- (c) the development of a stable, convenient "test-paper" for seminal acid phosphatase.

6 CHEMISTRY DIVISION

INTRODUCTION

The seven members of staff who were recruited in 1974-75 have now become experienced members of the Division and progress in research projects during the last year clearly reflects this. The organisation of the Division into three research groups, concerned with: (a) mass spectrometry; (b) glass, paint and fibrous materials; and (c) other evidential materials, has continued. Following the reorganisation of the laboratory in April of this year Dr M D G Dabbs (PSO) joined the Division and has started a special project concerned with the estimation of time of death. He also renders valuable assistance to the other research groups on statistical and electronic problems.

The project concerned with the multi-element screening of liver tissue by spark source mass spectrometry is now fully developed and unexpected elements have already been detected in livers from casework. The organic mass spectrometer has been used to assay tetrahydrocannabinol in blood plasma. Thermal analysis equipment is now being interfaced to the instrument for a detailed study of closely related polymers. The group has consisted of only three staff members for most of the year. This situation has temporarily eased due to the arrival of a research fellow and a student, both on one-year attachments.

The Link Systems Meca 10-4 energy dispersive X-ray fluorescence spectrometer has been installed during the year under the pre-production loan scheme for British equipment, operated by the Department of Industry. Rapid non-destructive methods of analysis are being developed for glass and paint and other materials have also been examined.

The discriminating power of microspectrophotometry has been investigated for the characterisation of fibre dyestuffs; the method appears to have considerable potential. The research group concerned with glass, paint and fibrous materials now has a staff of five and has been supported during the year by a six month student attachment. The appropriate research effort is now being devoted to these important materials.

During the year the soil project was successfully completed and the two members of staff in the other evidential materials group have since concentrated their efforts on important aspects of explosives residues and the identification of motor vehicle body fillers.

A pleasing feature of the year has been the introduction into operational laboratories of methods developed in research projects. The scheme of soil analysis is being evaluated at the Chorley laboratory and the flameless atomic absorption method for glass fragments has been introduced in the Nottingham and Chorley laboratories. Further methods of analysis should be available for operational use next year and special attention is being devoted to this aspect.

Samples from thirty one cases have been examined within the Division for the Forensic Science Service and in several of these new techniques have been employed.

MASS SPECTROMETRY

Thermal Analysis

The thermogravimetric analyser (Figure 10) has been installed and used in preliminary studies. The sample is heated under controlled conditions and any weight changes are monitored.

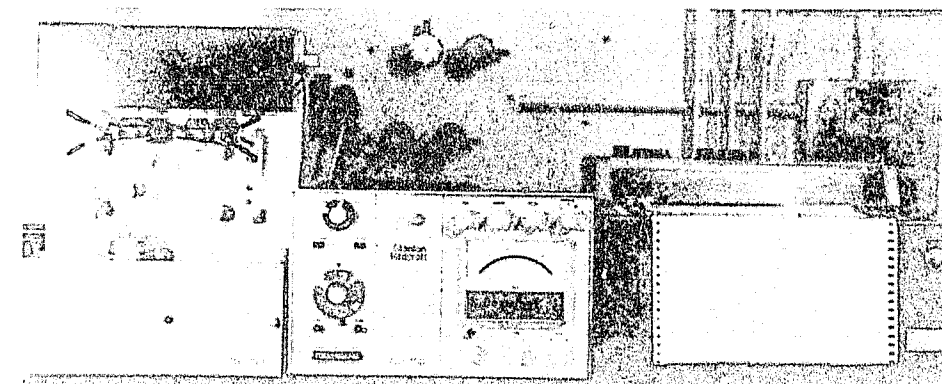


Figure 10: The thermogravimetric analyser

The percentage weight loss versus temperature curves for three white paints are shown as an example in Figure 11.

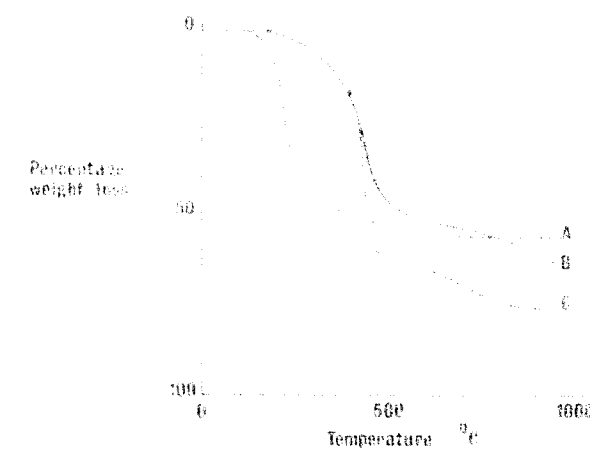


Figure 11: The percentage weight loss versus temperature for three white gloss paints; (A) acrylic, (B) epoxy ester and (C) nitro-cellulose, at a programmed heating rate of 50°C/minute

The curves for the three samples differ in the number of degradation steps, the temperatures at which these occur and in the proportion of residue which remains at 1000°C. The instrument is now being interfaced with the mass spectrometer via a capillary inlet so that, as well as measuring weight losses on the thermobalance, the corresponding evolved gases can be monitored continuously. This particular combination of techniques should prove very versatile and will, hopefully, extend the use of organic mass spectrometry to problems in general chemistry, particularly those involving closely related polymers. In the early stages of the project many spectral scans will need to be processed on the Hewlett Packard 2100 computer via the Carrick interface and the programs are currently being developed to achieve this.

Services for other divisions

Co-operation with Drugs and Toxicology Division has been extensive during the year. The development of a multiple ion detection procedure for tetrahydrocannabinol in blood plasma by GC-MS has required considerable effort but has proved successful and a number of samples from project work have been examined (refer to Figure 21 in Drugs and Toxicology Section). Analyses for salbutamol and orciprenaline in plasma are also under investigation using single-ion monitoring. A collection of spectra for known putrefaction acids has been prepared and a number of samples from related project work examined. Spectra for a collection of ergot alkaloids have also been recorded and a series of extracts has been examined during the course of a study of LSD metabolism.

Services for operational laboratories

During the year the number of entries in the forensic science 8 peak index has grown from 1,000 to 1,400 and a new listing for manual searching has been supplied to the operational laboratories (HOCRE Report 194).

Requests from operational laboratories for assistance with the interpretation of spectra are now being dealt with at the rate of 15 per month. On average a complete identification is made for 3 of these enquiries and for the remainder only a series of possible compounds or structures can be suggested. The systems used for this type of identification problem include collections of published spectra, the Wiswesser Structural Retrieval System and the Mass Spectral Search System. The number of compounds listed in the structural retrieval system now exceeds 4,000 and the mass spectral search system contains a collection of 40,000 spectra which is searched on a remote computer via the Cyphernetics network.

Casework requiring the use of organic mass spectrometry is now undertaken only in special circumstances. Seven cases in this category have been examined during the year.

Inorganic

Trace elements in liver tissue

The project concerned with the screening of liver tissue for trace elements is now at an advanced stage. A full casework service will be offered next year on completion of a survey of normal livers. Photoplates continue to be used for ion detection and these are read quantitatively on the Autodensitater. The Autodensitater now has 12k of computer core and this has allowed more advanced programs to be written and a standard automatic reporting procedure to be developed. A few elements, such as mercury and selenium, cannot be adequately covered by the screening procedure and complementary analyses are being developed for these elements, usually by flame atomic absorption spectrophotometry (HOCRE Report 206).

Livers from 16 cases of sudden death from drug overdose have been examined quantitatively for 12 elements to check the reliability of the procedure. Good agreement with "normal" literature values was obtained for all the elements studied. However, for some elements adequate data for normal livers are not available. A small number of case livers has also been examined during the year. The screening procedure scored its first success when high levels of iodine were detected despite some losses during ashing (Figure 12). The presence of iodine was not suspected and had not been detected by other methods. In a further case the presence of thorium was confirmed and in another an unusually high level of zinc, consistent with certain diseases, was detected (Figure 12).

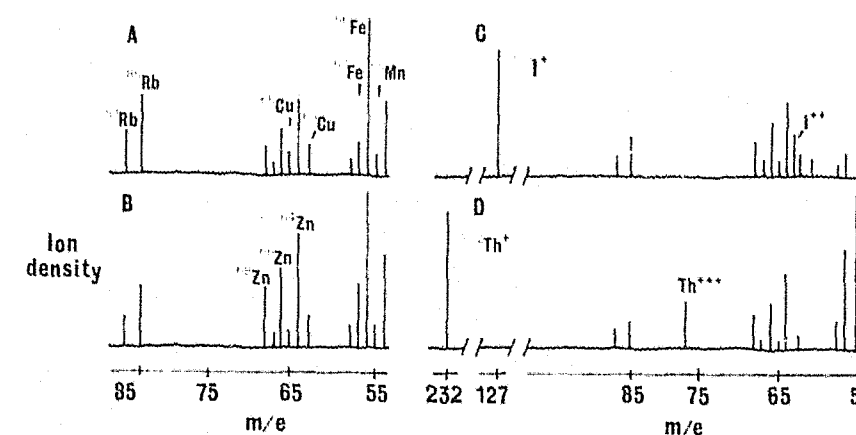


Figure 12: Illustrative portions of photoplates from the analyses of (A) normal liver (zinc level 47±14ppm) (B) liver containing elevated zinc level (125ppm) due to disease (C) liver containing iodine (20ppm) and (D) liver containing thorium (450ppm) from Thoratrast administered in 1949 and high levels of iron due to treatment for anaemia

High purity and ferrous metals

A study of high purity and ferrous metals is due to begin during the next year. The potential of the method for the analysis of small fragments of steel has been clearly demonstrated in a recent case. Some fragments of steel, weighing a few micrograms, were recovered from a hacksaw blade and it was suspected that they had come from the barrel of a sawn-off shotgun. In several cases of this nature examined in the past, the barrel had been constructed from a leaded steel but in this case a more conventional steel had been used. Two fragments from the blade matched the shotgun barrel closely but the evidential value of the comparison was unclear. Ten unrelated samples of steel were taken and using small fragments all of these were distinguishable from the barrel. The elements of particular value were arsenic, copper, manganese, chromium and cobalt. These results could not have been obtained by other techniques available in the Forensic Science Service. Project work will allow analytical procedures to be optimised and adequate background data to be accumulated.

Services for operational laboratories

In addition to the four cases already mentioned six other cases have been examined during the year. The analysis of glass was performed in 3 cases where 2 control samples could not be distinguished using physical properties. In two of these cases the matching controls could be discriminated and suspect fragments weighing 250µg - 1mg were successfully compared with the controls. The remaining cases involved the analysis of potassium in blood, the characterisation of an unusual metal alloy and the comparison of trace elements in two samples of synthetic fibre.

GLASS, PAINT AND FIBROUS MATERIALS

Glass

Three methods are now being developed for the analysis of glass fragments weighing in the region of 100µg, namely flameless atomic absorption spectrophotometry (FAAS), emission spectroscopy (ES) and energy dispersive X-ray fluorescence spectrometry (XRF). The three methods have been designed specifically to achieve the discrimination of window glass from other glass types on a routine basis, although some discrimination within the window glass population may also be achieved. When suitable methods have been developed for the elemental analysis and classification of small samples they will be used to examine the glass recovered during a survey of normal clothing in an effort to determine the origin of the various fragments.

Flameless atomic absorption spectrophotometry

The technique of flameless atomic absorption spectrophotometry (FAAS) for the analysis of iron and magnesium in 100µg fragments (HOCRE Report 176) has been used to examine a number of glasses of non-window origin. Members of staff were asked to submit a sample from any glass

object, other than a window, which was accidentally broken in the home. Although this survey is continuing 69 samples have now been analysed by FAAS and the results are plotted in Figure 13.

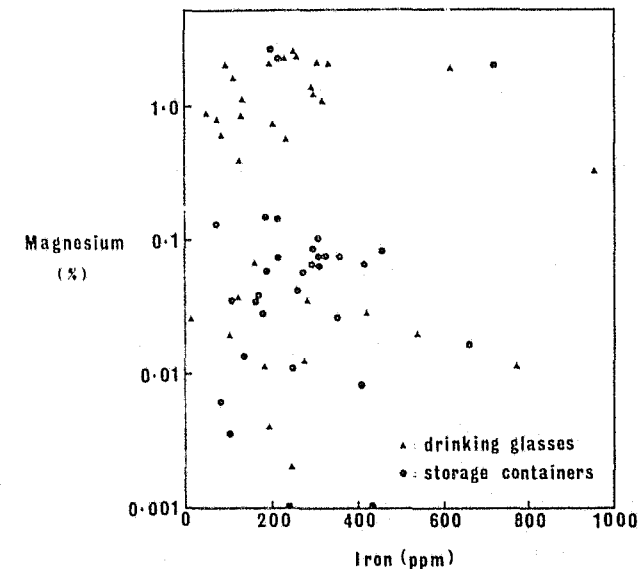


Figure 13: Iron and magnesium levels for a small collection of glass samples of non-window origin (typical levels for modern window glass are iron:1000ppm and magnesium: 2%-3%)

The levels of iron and magnesium in modern window glasses are typically 0.1% and 2-3% respectively. It is thus apparent that this method is very useful for classification purposes. Very few casework samples are too small to analyse by FAAS and so it is anticipated that this method will prove operationally valuable for many years.

Emission spectroscopy

Methods have already been developed within the Forensic Science Service for the quantitative analysis of glass fragments weighing a few milligrams. However our attempts to produce a quantitative method for fragments weighing about 100µg have not proved successful. The precision of replicate determinations was typically ±30% for elements of interest and therefore a qualitative approach is now being pursued for the classification of small glass fragments.

Samples are ground with graphite, containing lithium fluoride as flux, in an agate mortar. The powder is packed into electrodes and arced in an argon/oxygen atmosphere. Spectra are recorded on photographic plates using a six step sector. A small survey of 30 samples from the collection of glasses of non-window origin showed that only 3 samples could possibly have been misclassified as window glasses.

The time consuming steps in analysis by ES are the loading, developing and drying of photographic plates. The laser microspectral analyser (LMA1) has been fitted with a modified plate holder which contains a Polaroid Land film holder. This has allowed the routine analysis for major elements in other materials to be achieved in less than one minute. Attempts are now being made to find an appropriate film so that a similar procedure can be employed for glass analysis by conventional ES.

Energy dispersive X-ray fluorescence spectrometry

Glass fragments can be analysed rapidly and non-destructively by energy dispersive X-ray fluorescence (XRF) and the Link Systems instrument (Figure 14) is being evaluated for this purpose. It consists



Figure 14: The Link Systems, Meca 10-4, energy dispersive X-ray fluorescence spectrometer

of an air cooled X-ray tube and a dedicated minicomputer which acts as a multichannel analyser for the fluorescent X-ray energies and allows the spectra to be presented via a visual display unit or on an X-Y plotter. The integral floppy disc system enables up to 77 spectra to be stored on each exchangeable disc.

Spectra are initially compared on the visual display unit and then peak area ratios are obtained using the computer option for peak integration. Some problems are encountered when glass fragments are examined directly due to the effects of sample shape and thickness. These effects are minimal for the portion of the X-ray spectrum which lies below an energy of 7keV and fortunately most of the elements of interest

fluoresce in this region. At higher energies peak area ratios must be calculated for elemental lines which are adjacent to one another because these lines will be similarly affected by changes in sample thickness.

When milligram samples of synthetic glasses were analysed while supported by Mylar film, good linear relationships were observed between uncorrected peak area ratios and the appropriate true elemental ratios. A microsample holder has been constructed so that small samples can be reproducibly placed in the most intense area of the X-ray beam. The background from scattered X-rays is considerably reduced and with this holder samples as small as 100µg have been analysed using counting times of 600 seconds. The differences in iron and magnesium for 500µg fragments of a window and a container glass are shown in Figure 15. The full

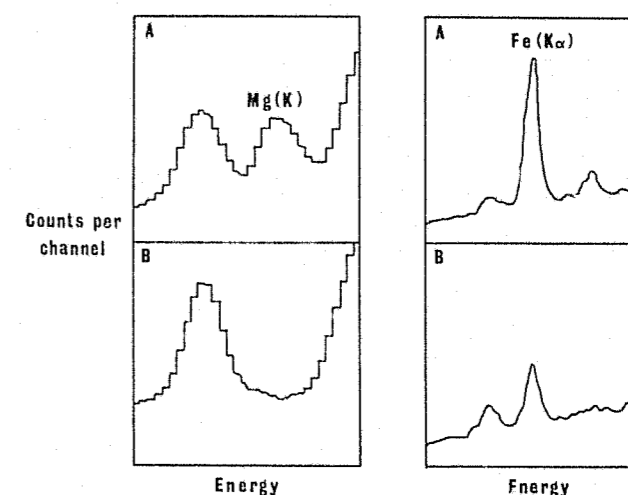


Figure 15: Sections of the XRF spectra, obtained in 600 seconds, from 500µg fragments of (A) window glass and (B) container glass showing different levels of iron and magnesium

spectra also showed a qualitative difference for arsenic and quantitative differences for potassium, rubidium and strontium. A great deal of work remains to be done but XRF already shows considerable promise for glass analysis in casework.

Paint

The X-ray fluorescence spectrometer has also been evaluated for paint analysis. Ten green and ten red paints of the same British Standard Colour, together with 10 white paints, were examined as 2mm x 2mm flakes. With the exception of one pair of white paints all the pairs of similar colour were distinguishable by visual comparison of the spectra and calculation of peak area ratios. These results are

superior to those achieved by any other technique on the same group of samples. On reduction of sample size results comparable with or better than other techniques were still achieved.

Again problems arise using XRF due to variations in specimen thickness, particularly with multilayered samples since it is difficult to estimate how many layers are being penetrated. Most of these problems can be overcome in a casework situation by choosing similar crime and control samples for comparison.

Small collections of multilayered paint flakes from Ford motor vehicles with two different original finishes, namely Daytona Yellow and Sebring Red, have been examined by XRF. Elemental differences were apparent between some samples of each type which were similar in microscopic appearance.

Spectra for two green household paints, two white household paints and two multilayered flakes of Ford Sebring Red, analysed through the topcoat, are shown in Figure 16. The counting time for each sample was 300 seconds.

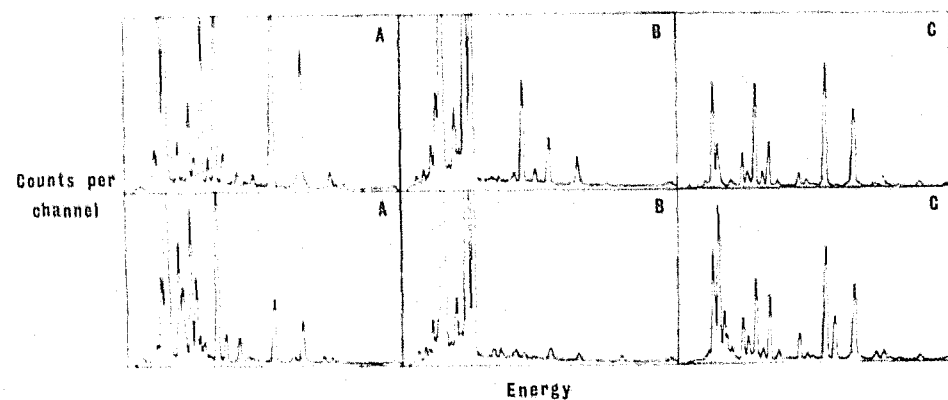


Figure 16: The 0-20keV spectra of (A) two green household paints, (B) two white household paints and (C) two multilayered paints with a similar Ford Sebring Red finish

Paint smears

The analysis of paint smears remains a problem although the laser microspectral analyser is sometimes helpful. The possibility of using XRF for these samples will be investigated later.

Characterisation of multilayered white paints

It has been shown that when multilayered white paint flakes from buildings are examined using the sequence: binocular microscopy, polarising microscopy and fluorescence microscopy both the number of layers recorded

and the consistency of results between observers, improves. The true number of layers for these particular samples was not known and therefore a series of white flakes of known layer sequence were prepared from common household gloss paints. Distinct layers are not easily observed for these samples even when they are mounted in epoxy resin to produce a good cross-section for microscopic examination. A series of reagents was applied to the cross-sections and one of these clearly revealed all the layers present in different shades of orange. The mechanism of the reaction is being studied but is not yet understood.

Fibres

Fibre dyestuffs

Fibre dyestuffs are characterised in operational laboratories by several different methods. The aim of project work in this area is to produce schemes of analysis which can be recommended for general use. Efforts have been initially concentrated on wool fibres since this is still the most common fibre type encountered in casework. Details of the methods currently in use in forensic science and industry have been collected and studied. Samples of 4 colours, which are known to be fairly common, have been collected from members of staff and from casework. Fibres of similar colour but of different origins have then been used to test various methods of dye extraction and analysis. The extracted dyes from single fibres of 1.5cm in length have been examined by visible absorption spectrophotometry and then subjected to thin layer chromatography (TLC). Many different TLC plates and solvent systems have been examined in order to choose the best procedures for small samples.

During the year an opportunity arose to examine the wool fibre collections using a Shimadzu MPS 50L microspectrophotometer at the Field Station of Imperial College at Ascot. Spectra were recorded from 20µm lengths of fibre and the discriminating power of this technique was compared with the discriminating powers obtained using solution spectra and TLC. The results showed that microspectrophotometry has considerable potential. The solution spectra recorded for 1.5cm samples of 4 blue wools of similar colour are shown in Figure 17 and the results obtained by microspectrophotometry for the same samples are shown for comparison in Figure 18.

Microspectrophotometry has several practical advantages over other techniques. The method is rapid, non destructive and can be applied to the smallest fibres encountered in casework. Any dyed fibre can be examined whereas with other techniques extraction difficulties are bound to arise from time to time. Perhaps the most important advantage is that a permanent record of the sample is produced so that data banks can be built up. Methods of storing and interpreting spectra are currently being investigated. Although the equipment is expensive it is already obvious that the Shimadzu, or a similar microspectrophotometer, would greatly enhance the value of fibre evidence.

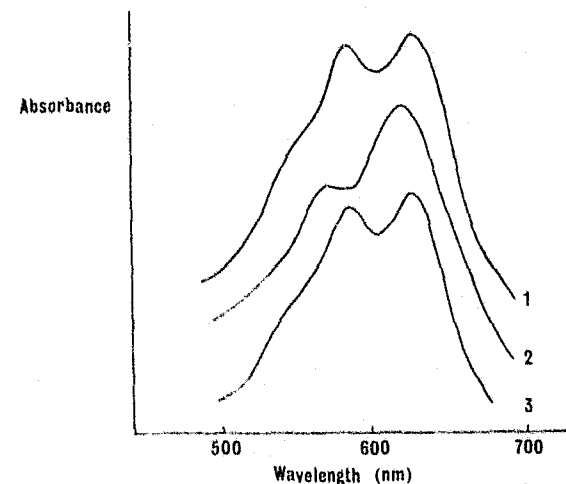


Figure 17: Visible solution spectra of the dyes extracted from 1.5cm lengths of three microscopically similar blue wool fibres

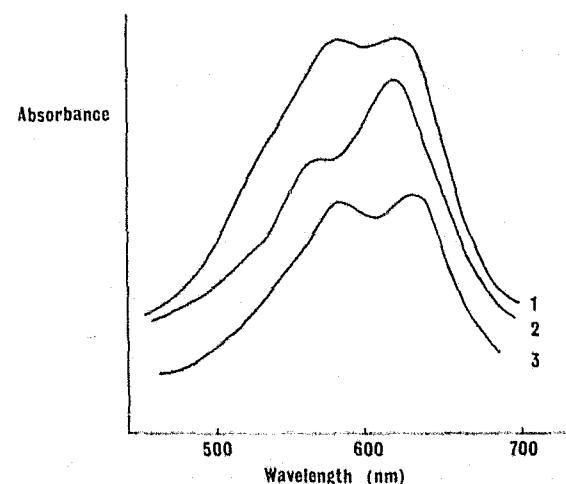


Figure 18: Spectra of the three blue wools shown in Figure 17 obtained on 20µm lengths of fibre using the Shimadzu MPS 50L microspectrophotometer

Trace elements in synthetic fibres

The compilation of data concerning trace element levels in synthetic fibres is complete and practical work has shown that spark source mass spectrometry and XRF can be successfully used on large samples. The only method found suitable for the multi-element analysis of single fibres was proton induced X-ray analysis (PIXA). However, if a large sample of the control fibre is characterised first, analysis for specific elements can be achieved on single fibres using FAAS.

Hair

The levels of zinc along the lengths of hairs from several individuals have been determined by FAAS. Although distinct profiles were not observed, a few individuals showed distinctive and reproducible zinc concentrations. Further multi-element studies are in progress at AERE Harwell using PIXA and further work in the division may be undertaken when the results of this study are available.

Services for Operational Laboratories

The Division continues to supply the Service with calibrated silicone fluids and standard glasses of known refractive index. The use of a precision refractometer together with checks using the standard glasses allow more accurate calibration of fluids than has previously been possible. In an attempt to improve consistency further, silicone fluids are now being purchased in large batches which will last for several years.

The operational laboratories have been assisted with 7 cases during the year which involved the qualitative and quantitative analysis of metals by XRF. In one case glass fragments weighing between 24µg and 100µg were successfully analysed by FAAS and in another case very small metal spheres were analysed using the LMA1. In a case where 2 large samples of nylon fibre had to be compared a complete dyestuff analysis and a trace element comparison were carried out.

OTHER EVIDENTIAL MATERIALS

Explosives Residues

A study has been made of various swab materials and solvents which can be used to recover commercial explosives from hands. Although cotton wool was satisfactory as the swabbing material the more usual solvents such as ether and acetone could not be recommended. Ether showed a low recovery compared to other solvents and co-extracted considerable amounts of materials which interfered with analysis using gas chromatography with electron capture detection (GC-ECD). Acetone was efficient but produced even higher levels of interfering materials from blank hands. When the hands were swabbed with water and the water was extracted with ether prior to analysis, both high recoveries and low blanks were obtained. On this basis a simple kit containing cotton wool and about 2ml of distilled water would be feasible. However, when the aqueous solutions from hand swabbing were stored the levels of nitroglycerine (NG) decreased

rapidly over a 2-day period and the solution became cloudy. This effect was found to be due to the growth of micro-organisms and work is in progress to find a suitable preservative.

Very few studies have been reported concerning the amounts of explosive which are transferred to hands during various activities, or concerning how long the explosive can be detected on the hands afterwards. A quantitative study of both these factors has therefore been made using GC-ECD. When well wrapped sticks of commercial explosives were gripped in the hand about 100 µg of NG were detected whereas using poorly wrapped and sweaty sticks about 50 µg were found. The kneading of raw commercial explosive in the hand produced several milligrams of NG contamination. The transfer of explosive from hands to glass objects has also been studied together with the amounts of explosive picked up by a second person who handled the same object soon afterwards.

The persistence of NG and ethylene glycol dinitrate (EGDN) on hands has been determined in detail for many individuals by applying the explosive to their palms in solution (HOCRE Report 190) and for some individuals who actually handled explosive sticks. When milligram amounts of explosive were applied to the hands EGDN was detected for up to 3 hours and NG for up to 24 hours. Washing the hands with soap and water was found on average to remove 70% of the NG present.

Gunshot Residues

The detection of organic propellant residues on hands after a weapon has been fired has not proved reliable. The estimation of total antimony, barium and lead also appears, from the literature and previous work in the Division, to lack the required specificity. During the year a new method, involving the examination of tapings from hands for particulate residues using electron microscopy and electron probe analysis, appeared in the literature. This method seems to have the required specificity but can take up large amounts of instrument time. A non-destructive method is therefore being sought for the presumptive testing of tapes prior to examination in the electron microscope.

Motor Vehicle Body Fillers

Paint flakes obtained in non-stop traffic accidents often have a layer of body filler underneath where previous accident damage has been repaired. No schemes of analysis currently exist for the body fillers used in this country and therefore a number of commercially available samples has been collected for study. Nearly all the compositions consist of a styrenated alkyd filled with crude talc and sometimes a pigment to colour the material. Pyrolysis gas chromatography (PGC) using a Curie Point Pyrolyser and temperature programming has been found to be effective in discriminating many of the samples of similar appearance. The pyrograms for two body fillers are compared in Figure 19. The traces for PGC are standardised by pyrolysing a sample of polythene which produces a well defined series of hydrocarbons. A graph of the retention time of the aliphatic hydrocarbons versus the carbon number produces a relationship for calibration which is linear between C₉ and C₁₇. This graph is then used to convert the retention times of the peaks for the body filler

into reproducible methylene units. As styrene is usually the most intense peak this is arbitrarily assigned a value of 100 and the intensity of all the peaks is recorded in proportion. Any peaks which are known to have no discriminating power are eliminated. The resultant bar charts,

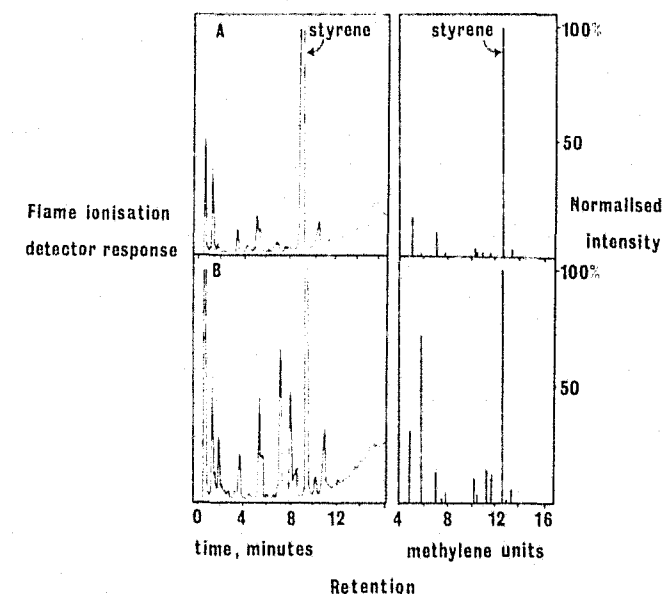


Figure 19: Pyrograms from two different motor vehicle body fillers (A and B) on Carbowax 20M columns and the constructed normalised bar charts

which are also shown for the two body fillers in Figure 19, are reproducible and much easier to store and interpret than the raw data.

Trace elements in the body fillers are being examined using XRF and samples are also being collected from casework so that the frequency of occurrence for a particular type of filler can be determined.

Soil

The soil project was brought to a successful conclusion during the year and the methods of analysis developed are now being evaluated in casework at the Forensic Science Laboratory, Chorley.

Density gradient columns were found to be highly reproducible for 50mg samples of material, but offered only moderate discrimination between soils of the same colour. Although of limited discriminating power, density gradient columns are undoubtedly of value particularly when the sample of soil is small (<200mg). However, results can only be recorded photographically with some loss of information.

A simple and novel procedure was developed for the comparison of particle size distribution. This procedure showed that sieving the sand

fraction and examining the silt fraction with a Coulter Counter provided much higher discriminating powers than any of the other methods examined. It must be remembered, however, that the analytical methods have only been applied to soils from Berkshire and its bordering areas and that the same results may not be obtained in other areas of the country.

The methods developed for soil analysis have all been evaluated using five simulated scenes of crime. Multiple control samples taken with a spoon from each scene were compared with soil removed from items such as shoes, car tyres and plant roots. Of the methods studied only saccharide content gave any significant variation within any of the scenes, while dry colour, ashed colour, pH, density gradient patterns and particle size distributions were all reproducible within each of the scenes. The results of this study showed that it is important to take multiple control samples, perhaps six, normally from the surface of the soil so that the variation over the scene for each parameter studied may be assessed.

Reports describing the above work in detail have been prepared and will be available shortly.

SPECIAL PROJECTS

Three special projects have been started but each is still in the early stages.

Time of Death

The estimation of time of death is often of crucial importance in major police investigations. Although a number of measurements have been suggested to complement the pathologists experience, temperature remains by far the most popular method. Current practice which involves temperature measurement at one site tends to yield imprecise estimates of the post mortem period. A project has therefore been started to investigate whether significantly improved estimates can be obtained by using electronic thermometers positioned at several sites in the body, followed by computer routines for fitting the multiple cooling curves obtained. Expanded plastic blocks soaked in water show similar cooling curves to cadavers and these are currently being used as simulated tissue to study the form of the cooling curves and to estimate the time at which cooling began, which in this particular instance is already known.

Statistical Interpretation

The assessment of the evidential value of trace materials found in casework is always a problem and it is hoped that a number of such problems will be investigated. A start has been made concerning the interpretation of glass cases where, in addition to fragments matching the control sample, a substantial number of extraneous fragments are present. Sufficient data already exist within the laboratory to provide a basis for investigating the statistical aspects of this problem.

Vehicle Collisions

A project has also been initiated to study the micro and macro deformations which occur when two vehicles are in collision. At the present time damage is described to the court in general terms by the police and sometimes photographs are produced. When two vehicles have been in collision it seems likely that the resultant damage is characteristic of that particular accident. Damaged areas are being studied to determine if it is possible to obtain conclusive evidence that two particular vehicles have been in collision.

INTRODUCTION

Arising from the reorganisation which took effect in April the Toxicology Division and the Drugs of Abuse Division together with the Drugs Intelligence Laboratory have been combined. This arrangement has led to increased administrative efficiency and has also brought the Establishment into line with the situation that is usually found in the operational laboratories. During the year research has continued along the lines detailed in last year's Report with effort being directed along three main fronts. Firstly, there are those projects aimed at developing assays for the isolation and quantitation of individual drugs. Secondly, there are those for assessing and developing new analytical techniques and procedures and for collecting background information on existing ones and finally there are those projects directed towards recording analytical data for drugs and other materials and which correlate information from cases involving drug offences. One new programme was initiated following the recommendation in the Report of the Departmental Committee on "Drink and Driving" under the Chairmanship of Mr F Blennerhassett QC to replace blood sampling with breath analysis. Progress in the individual projects is described in greater detail as follows.

INDIVIDUAL DRUGS

LSD

The two LSD radioimmunoassays (RIA) developed last year have been completely evaluated, and they have been shown to be highly specific for LSD and its metabolites and capable of detecting the presence of less than 1ng LSD/ml. Additionally, the two assays differ in specificity for some metabolites and this can give extra useful information with some samples. During the year samples of urine, serum and stomach washings from 31 cases were submitted for analysis from the operational laboratories. The samples are first screened by RIA and if positive they are analysed by HPLC with fluorimetric detection. In many cases, fluorescence spectra can be determined on LSD as it elutes from the column. A further portion of the case material is fractionated by HPLC and the fractions examined by RIA. All positive urines examined to date have given one peak of activity in the fractions where LSD is expected to elute and at least one other peak due to more polar compounds. Some effort has been made to identify these metabolites but, due to their low concentration and the lack of synthetic samples for comparison, this has not proved possible so far.

The sensitivity of the method is illustrated by the results obtained with a urine sample taken from a girl four days after the admission to hospital with an acute psychotic reaction, when the level of LSD detected by the initial RIA was found to be 2ng/ml. After fractionation the peak of reactivity corresponding to LSD indicated a level of 750pg LSD/ml, which was confirmed by the HPLC fluorescence method. The whole analysis was performed on less than 10ml of sample.

Insulin

Further work has been done on the problems of measuring insulin in post-mortem tissues and the interpretation of results. Experience has been gained in applying the extraction method already developed to tissue from 4 cases of suspected insulin overdose. In this way more background data on endogenous insulin levels in tissue and urine have been acquired.

Levels found in tissues from non-diabetics can now be interpreted with some confidence but further work is needed to establish "normal" levels in diabetics' tissues.

Benzodiazepines

Effort has continued into examining methods of analysis for benzodiazepines, their metabolites and the corresponding benzophenone hydrolysis products. The use of a proteolytic enzyme subtilisin, which is described below, has significantly improved the yields extracted from tissues and a method combining the enzyme digestion with reverse phase HPLC which permits quantitative as well as qualitative analysis of these drugs at the nanogram level has been reported (HOCRE Report 202).

The UV spectra of 15 benzodiazepines in acid and alkali and the associated benzophenones in ethanol have been prepared and circulated to the operational laboratories and, in addition, a screening colour test based on a modification of the well known Marquis test which can also be used for quantitation has been developed. When heated with this reagent, benzodiazepines, with the sole exception of chlordiazepoxide, give varying colours ranging from yellow through to orange to pink depending on the drug. The benzophenones give colours without heating. Compounds shown to cause interference in this test were chlorpromazine, chlorprothixene, oxytetracycline and tryptamine but these could be separated from benzodiazepines by TLC on silica gel using chloroform/ethanol 95:5 v/v. It was noted that the recoveries of benzodiazepines from TLC plates using 2N H₂SO₄ to back extract the drugs from ether sometimes gave poor yields but these were dramatically improved using 5N HCl.

Cannabis

The Division has been fortunate in receiving both urine and plasma samples from individuals who have smoked known quantities of THC impregnated cigarettes. These were supplied by Professor J W Thompson's group at Newcastle University. The RIA procedure described in last years report has been used:

- a) to assay the plasma and urine samples directly;
- b) with HPLC to examine RIA cross-reacting metabolites in urine;
- c) with HPLC to quantify THC in the plasma samples.

During the first two hours after smoking a cigarette containing 10mg of THC the levels of RIA cross-reacting cannabinoids in plasma were between 80ng/ml and 5ng/ml. In urine over the period up to 24 hours after smoking the levels were between 150ng/ml and 2ng/ml.

As a preliminary to investigating the structures of the RIA cross-reacting metabolites in human urine, THC metabolism has been examined in the rabbit. A rabbit was injected intravenously with radio-labelled THC and urine samples were collected. Fractions of the hydrolysed urine were chromatographed using HPLC and then counted. These data were used to plot a radiochromatogram representing the total metabolite elution pattern. In addition the eluent fractions were assayed with the cannabinoid RIA so enabling those metabolites present in rabbit urine that cross-reacted in the assay to be detected. Two metabolites in the rabbit urine were found to cross-react, one of which had a retention volume equivalent to CBN.

The HPLC/RIA procedure was also used to quantify the cross-reacting cannabinoids present in human plasma. Plasma extracts have been chromatographed, assayed and the elution pattern of cross-reacting cannabinoids determined. The resulting radioimmuno chromatogram (Figure 20) showed the presence of components thought to be polar

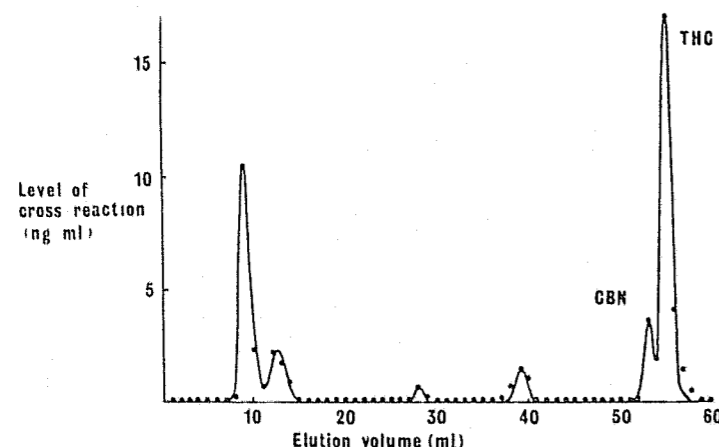


Figure 20: Radioimmuno chromatogram of a cannabinoid containing plasma extract

metabolites and conjugates and two other peaks of cross-reaction with retention volumes corresponding to THC and CBN

A further method for THC measurement in plasma using GC/MS has been evaluated. THC was isolated from plasma samples by HPLC and the eluent fraction corresponding to THC analysed by GC/MS using deuterated THC as an internal standard (Figure 21).

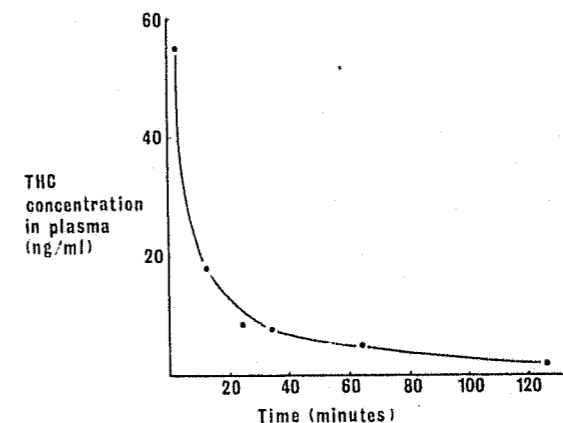


Figure 21: Plot of THC concentration in plasma with time from a subject who had smoked a cigarette impregnated with 10 milligrams of THC

The RIA has been used for both plasma and urine case samples sent to CRE from operational laboratories. Positive results were obtained with four of the seven cases so far examined.

Fluoroacetate

Work has continued with the aim of devising a screening procedure which could be used prior to the Gas Chromatography - Mass Spectrometry (GC/MS) method described last year. In the body fluoroacetic acid is metabolised to fluorocitrate which inhibits the enzyme aconitase. As a consequence the metabolic cycle (part of which is shown below in Figure 22) is halted and death ensues.

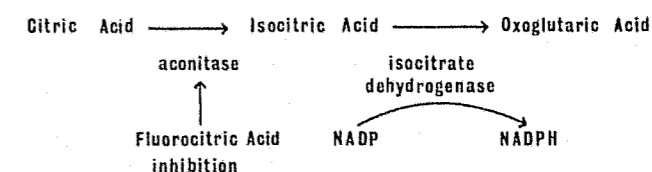


Figure 22

Addition of an extract of an aluminium chloride deproteinised liver from a fluoroacetate-poisoned guinea pig to a buffered citrate-aconitase - isocitrate dehydrogenase - NADP system immediately revealed the inhibition of aconitase by a sharp alteration in the rate of increase of the absorbance at 340nm.

Using 'spiked' human liver this inhibition could not be demonstrated due to the level of isocitrate already present. A method for selective removal of isocitrate is being developed.

Alcohol

As reported last year, Carbowax A coated with 0.4% Carbowax 1500 is no longer commercially available; it has been replaced with Carbowax C coated with 0.2% Carbowax 1500. This new column packing material has been evaluated, and found to be as suitable for blood alcohol analysis as the previous system (Carbowax A coated with 0.4% Carbowax 1500) (HOCRE Report 183). In addition, Carbowax C 80-100 was found to have a superior separating power to Carbowax A 60-80.

The testing of breath testing devices for use under the provisions of the Road Traffic Act 1972 has continued.

Salbutamol

It was difficult to repeat a published method in the literature employing GC/MS single ion monitoring on the silyl derivative of salbutamol from plasma extracts containing therapeutic levels of the drug although the procedure was satisfactory for urine where the levels are much higher. Accordingly, a reverse phase HPLC technique that had been published for catecholamines in which a surface active agent is added to the eluent was modified and using fluorimetric detection it promised to be adequate to deal with therapeutic levels in both plasma and haemolysed blood.

ANALYTICAL TECHNIQUES AND PROCEDURES

High Performance Liquid Chromatography

The notable feature of the past year has been the greater use of HPLC compared with GLC in the toxicological and drug analysis programmes.

The major project undertaken has been the application of HPLC to the investigation of the metabolism of LSD.

¹⁴C labelled LSD, ³H labelled LSD and unlabelled LSD were administered orally to Rhesus monkeys and samples of blood, urine and faeces were collected over 48 hours. Using reverse-phase liquid chromatography, urine and plasma samples could be fractionated without prior extraction and the fractions examined for radioactivity or cross-reactivity by radioimmunoassay. In this way, the metabolites, however polar, were not lost and a metabolic profile for LSD could be determined at different times after drug ingestion. This work has been useful in the development of the method described earlier for the routine analysis of LSD in case samples.

Several other cases have been received for analysis by HPLC. One of the more unusual involved the detection of psilocin in mushrooms (*Psilocybe semilanceata*), where HPLC was valuable in separating this rather unstable psychoactive drug from closely related substances.

HPLC has been used routinely for the analysis of benzodiazepines and their metabolites, for THC, and for salbutamol.

New techniques in liquid chromatography involving ion-pairing have been examined briefly, and results appear promising for highly polar or polyfunctional substances. A commercially available electrochemical detector has been received for evaluation. The device has potential as an almost universal and sensitive HPLC detector but so far has failed to perform satisfactorily.

Radioimmunoassay

Reference has already been made to this technique in connection with the LSD, THC and insulin assays. During the year in addition to the internal programmes studying the metabolism of THC and LSD, 30 LSD, 7 THC and 4 insulin assays were undertaken for the operational laboratories. To accommodate this increase in the number of assays a β -counting head was fitted to the 400 channel γ -counter.

In December 1975, in keeping with the general policy of handing over developed methods to the operational laboratories, the Aldermaston Laboratory took over digoxin assays for the Forensic Science Service albeit using the HOCRE counting facilities. Since that time further work has been done on this assay using reagents from the Radiochemical Centre with a resultant improvement in accuracy and precision.

Recent developments in the technique of enzyme linked immunoassays (EMIT) for drugs have been followed with great interest. Although the sensitivity of the technique is, in general, an order of magnitude less than that of the RIA it is cheaper and quicker and in view of these advantages the results from a commercial kit are to be compared with conventional RIA.

The Use of Enzymes to Release Drugs from Tissues

A new method has been developed to liberate tightly protein-bound and chemically labile drugs from human tissues using the proteolytic enzyme subtilisin Carlsberg. Far greater yields are achieved than with the classical procedures and the method has been applied to the release of benzodiazepines and other basic drugs. The advantages of the technique include:

- a) simplicity, speed and cheapness;
- b) drugs and their metabolites are released from tissues in an unchanged form as a consequence of the mild conditions employed;
- c) enzyme hydrolysed liver may be directly extracted with organic solvents without risk of emulsion formation.

The results shown in Table 3 demonstrate the improved drug yields from case livers using the subtilisin method.

TABLE 3

DRUG YIELDS RECOVERED FROM LIVERS USING THE SUBTILISIN AND ACID HYDROLYSIS METHODS

Case	Compounds Present	Drug levels found $\mu\text{g/g}^{-1}$	
		Subtilisin method	Conventional Acid Hydrolysis method
1	Diazepam	21.5	1.2
2	Chlordiazepoxide	3.6	0.2
3	Oxazepam	9.7	0.4
4	Amitriptyline	7.9	3.9
5	Chlormethiazole	230.0	106.0
6	Chlorpromazine	29.7	18.4
7	Viloxazine	24.2	11.8
8	Dextropropoxyphene	93.0	0.0

Work is currently in progress to apply this method for the rapid detection of compounds normally extracted from acid fractions such as barbiturates and salicylic acid derivatives in an attempt to provide a single method for the release and analysis of all classes of drugs from one liver digest. This approach is also being applied to the extraction of therapeutic levels of drugs from blood.

Automatic Urine Extractor ("AUPEX")

Work continues on this equipment to cure problems arising from the failure of the interface detectors. These were tested in isolation by using a simulator and by monitoring the potential across the contacts of the detectors when layered mixtures of ether and aqueous hydrochloric acid were passed through them. The results suggested that failure was probably due to the accumulation of aqueous droplets in the region of the contacts within the detector. By using a different shaped contact made of "Kel-F" significant improvements were observed and the modified detector is to be incorporated into AUPEX for further trials.

Action of Chloroform on Tricyclic Antidepressant Drugs

The project to study the interaction between chloroform and amitriptyline, following acid hydrolysis of tissues (HOCHE Annual Reports 1974 and 1975) has been extended to include a range of common tricyclic antidepressant drugs. Table 4 shows the extraction recoveries of various drugs using either chloroform or ether from alkaline deproteinised liver filtrates at concentrations of $25\mu\text{g/g}$.

TABLE 4

EXTRACTION RECOVERIES OF DRUGS FROM ALKALINE DEPROTEINISED LIVER FILTRATES

Compound	% Recovery	
	Chloroform	Diethyl ether
Strychnine	78	88
Amitriptyline	0	73
Chlorimipramine	0	66
Dothiepin	45	51
Doxepin	37	60
Imipramine	0	76
Nortriptyline	0	75
Protriptyline	0	71

The reason for these differences has not been conclusively established but it is noted that those drugs that give poor recoveries possess the greatest intra-molecular strain.

Stability of drugs to putrefaction

Arising from an observation made in 1970 during work on the putrefaction acids and bases project an initial study has been made on the stability of 4 drugs in putrefying livers under ambient conditions. Over a $7\frac{1}{2}$ week period when the daytime temperature was around 16°C total loss of chlorpromazine occurred in contrast to 10-20% losses for dextropropoxyphene, diazepam and strychnine. Over the same period when the temperature ranged from $30-32^{\circ}\text{C}$ total loss of chlorpromazine again occurred but this time the losses of dextropropoxyphene and diazepam were increased to 60% and that for strychnine to 40%.

COLLECTIONS OF ANALYTICAL AND INTELLIGENCE INFORMATION

Collection of Analytical Data for Drugs

Progress has continued with the programme outlined in last years report to produce data sheets for drugs and the first hundred together with indexes have been circulated. To assist with matching the spectrometric and chromatographic properties of unknowns with those of drugs for which data sheets exist, computer programs have been written in conjunction with the Information and Chemistry Divisions based on the discrepancy index concept. Figure 23 shows the computer dialogue

to identify an unknown from three Rf values with the final listing of the ten most likely identities in descending order of priority.

```

**SYSTEMS AVAILABLE**
TLC 0-1 0-1 CHROM.MUTHER ACTIONS
GLC SE30 4
UV ACID MAX. 0-1 CHIEF 0-1

WHICH SYSTEM DO YOU REQUIRE?
SYSTEM TIC 0-1 0-1

RAW OR CORRECTED DATA?
RAW
VALUES 0-1
INSERT YOUR FOUR STANDARD VALUES 0-1 0-1 0-1 0-1

SYSTEM TIC 0-1 0-1 0-1

RAW OR CORRECTED DATA?
RAW
VALUES 0-1
INSERT YOUR FOUR STANDARD VALUES 0-1 0-1 0-1 0-1

SYSTEM TIC 0-1 0-1 0-1

RAW OR CORRECTED DATA?
RAW
VALUES 0-1
INSERT YOUR FOUR STANDARD VALUES 0-1 0-1 0-1 0-1

**DATA TO BE USED**
SYSTEM VALUE 0-1 0-1
1 0-1 0-1 0-1 0-1
2 0-1 0-1 0-1 0-1
3 0-1 0-1 0-1 0-1
101 RECORDS SEARCHED
0-1 0-1 AT 0-1 LEVEL AND 0-1 AT THE 0-1 LEVEL

  11  12  13  14  15  16  17
IDENTIFAMINE 0-1 0-1 0-1 0-1 0-1 0-1 0-1
METHUONE 0-1 0-1 0-1 0-1 0-1 0-1 0-1
DIETHYLPROPION 0-1 0-1 0-1 0-1 0-1 0-1 0-1
DIETHYLGLYCOLATE 0-1 0-1 0-1 0-1 0-1 0-1 0-1
DEXTROPROPIONPHENE 0-1 0-1 0-1 0-1 0-1 0-1 0-1
ETHYLBROMAZINE 0-1 0-1 0-1 0-1 0-1 0-1 0-1
METHAQUALONE 0-1 0-1 0-1 0-1 0-1 0-1 0-1
LIGNOCATINE 0-1 0-1 0-1 0-1 0-1 0-1 0-1
COCAINE 0-1 0-1 0-1 0-1 0-1 0-1 0-1
PRAMOXINE 0-1 0-1 0-1 0-1 0-1 0-1 0-1
ANOTHER TEN ANSWERING

```

Figure 23: Computer Output Using the Compound Identification Program

Interfering Acidic and Neutral Compounds of Putrefaction

Since the last report a further nine acidic and three neutral putrefactive compounds have been characterised bringing the total number of compounds examined to 49 and 5 respectively. The UV and MS of all the compounds have been recorded as well as their Rf values on 3 TLC systems (chloroform-n butanol-acetic acid and ethyl acetate - chloroform - acetic acid on silica gel and n butanol - water on borate-coated silica gel). The retention indices of the acids or their methyl esters on SE30 have also been determined. In addition HPLC assays, colour tests and spray reagents have been developed for all the compounds.

Drugs Intelligence Laboratory

Trends in drug abuse in the UK continue to be monitored through regular contact with the operational forensic science laboratories and the Laboratory of the Government Chemist. During the year 982 cases were notified with 245 samples submitted for further examination. The

commonly abused drugs such as LSD, cocaine, morphine, opium and hash oil continued to appear at similar levels to last year but of particular note was the increased abuse of amphetamine sulphate in powder form which started towards the end of last year. Several drugs appeared for the first time including diethylpropion, norpseudoephedrine and psilocin in mushrooms (*Psilocybe semilanceata*).

The laboratory continues to provide an information service to the operational forensic science laboratories on drugs of abuse, clandestine synthetic methods etc. by phone or telex and through the bimonthly bulletin "Drug Abuse Trends". In addition, close liaison has been maintained with similar laboratories in America, Australia, and Canada, the CDIIIU and the Home Office Drugs Branch. During the year a report was circulated (HOCRE Report 187) on the techniques used in the physical examination of tablets and work continued on the comparative studies of hash oil and amphetamine sulphate as well as on the development of new methods for the examination of illicit preparations.

BLENNERHASSETT GROUP

Following the recommendation of the Interdepartmental Committee on Drink and Driving under the Chairmanship of Mr F Blennerhasset QC to replace blood sampling with breath analysis, a group was formed in April to evaluate the currently available substantive and screening breath alcohol devices for possible use by the police. The personnel for the group have been drawn from CRE and from the Aldermaston and Metropolitan Police Forensic Science Laboratories and they are in temporary accommodation on the Atomic Weapons Research Establishment site. After invitations to manufacturers to submit equipment for assessment, devices have been received from the United Kingdom, Canada, Europe and USA based on various physicochemical processes including gas chromatography, chemical oxidation, fuel cell oxidation, infrared absorptiometry etc. Detailed tests including trials both with breath alcohol simulators and with drinking subjects are in progress.

Following the reorganisation of the Establishment in April the work of external contracts was transferred to the Division. The primary function of the Division continues to be the provision of scientific and technical information in support of police enquiries but the Division is now able, through external contracts, to extend the support given to forensic scientists to the provision of equipment, specially commissioned research reports and a wider range of collections of data. At the same time, some changes have been made in the way external contracts are initiated and pursued to enable a fuller exchange of the views of specialists. A summary of the functions of the five sections of the reorganised Division can be seen in the list in Appendix B. The progress made in each section during 1976 is described below.

INFORMATION COLLECTION AND PRESENTATION

Literature Scanning and Searching

The Establishment now takes ninety-five journals which are scanned by the staff of the Division. Chemistry and Biological profiles are run on UKCIS Chemical Condensates and Biological Abstracts and the profiles themselves are in the process of being revised. In addition, Current Contents and government establishment publication lists are searched. In this way about 200 papers are selected for the file each month. The file now numbers some 24000 papers. Between 30 and 40 papers, which are felt to be of immediate interest to the operational scientists, are copied and circulated to the forensic science laboratories every month and each laboratory has an up to date set of microfilm copies of all the papers which they can refer to. The number of enquiries is on the increase and has now reached about 120 per month.

Author Title Index

The Division is experimenting with an Author Title Index (ATI). The use of this index enables a search to be made of the records by author, title of article, or journal name. A list of all the records that have been added to the file each month can be circulated. Chorley and Bristol Forensic Science Laboratories are assisting with an evaluation of the experiment. An example of part of one of the monthly ATI lists is shown in Figure 24.

A.T.I. Listing Dated:09/12/76

- 23671 Anon;
How long dead?
Brit Med J;1976;V2;661
- 23673 Rennie J G;
Spontaneous explosion of glass door
Brit Med J;1976;V2;704
- 23677 Sturmer W Q; Spruill F G;
Accidental asphyxial deaths involving infants and young children
J Forens Sci;1976;V21(3);483

Figure 24: Sample of the Author Title Index (ATI)

Vehicle Information

During the past year the number of enquiries for information relating to motor vehicles has risen to about one-fifth of the total number of queries. A preliminary report giving information on the frequency of occurrence of vehicle paints has been circulated. An indication of the type of useful information that the data collection is capable of producing is given in Figure 25.

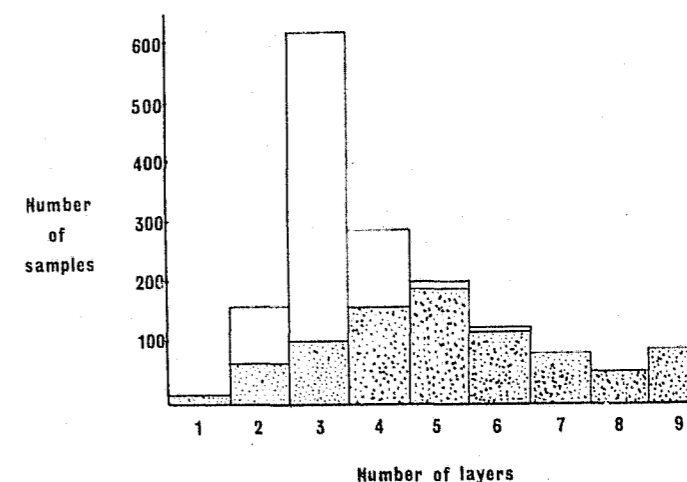


Figure 25: Distribution of paint layer structures found on control samples from 1600 vehicles encountered in casework

Key: - All vehicles - Resprayed vehicles only (54% of total)

This histogram shows the frequency of occurrence of total layer structures for the 1600 control vehicle paint samples currently on file.

The Colin Tippett Collection consisting of vehicle paints in use since 1961 has been recoded using the systems recommended by the Advisory Committee on Paint and the data stored on computer (HOCRE Report 195). Undercoat data from foreign manufacturers have been collected and, after collation, will be added to the reference data on computer and also distributed in hard copy form to each laboratory.

Photographs and associated information on 398 headlamp lenses are now available in the laboratory. Another 85 headlamps have been obtained and their photographs will be distributed shortly. A start has been made on the collection of information on sidelight units; at present data on some 500 sidelight units are available. Due to the expected size of the complete collection, all details from the units are being stored on computer for retrieval purposes.

QUALITY CONTROL AND COLLECTION OF CASEWORK DATA

The quality control experiments which involve the weekly supply of aqueous ethanol standards and the fortnightly supply of blood ethanol standards to the operational forensic science laboratories have continued throughout the year.

"Blind trials" involving quality control monitoring were initiated during the past year in fields other than alcohol analysis. In this type of testing, cases are prepared at HOCRE and submitted to the operational forensic science laboratories through normal police channels. These cases, once received at a laboratory, are examined using the normal procedures. Laboratory reports are prepared and submitted to the police officer in the case who, in due course, returns the report to HOCRE. The results from these trials are collated and reported by staff at HOCRE.

Three blind trials have been conducted during the year, viz:

- (a) the examination of clothing and glass exhibits for blood and glass contact traces in a fictitious "break-in";
- (b) the examination of vehicle paints, both controls and debris from the scene, to establish vehicle to vehicle contact;
- (c) The examination of microdot tablets for traces of controlled drug substances.

Considerable progress has been made during the year on the collection of data from case reports:

Tyres - data continues to be collected and the number of records on file now exceeds 7000. The file is being reviewed in January 1977 when it is anticipated that an optical mark card will be designed for collecting data thus easing the data processing demands;

Glass - the collection of refractive index data is being continued and the number of records on file is almost 6000. The data have been collated and circulated (HOCRE Report 186). The system of data collection has been reviewed and it is expected that data will be collected on optical mark cards early in 1977;

Toxicology - an optical mark card has been designed to collect comprehensive data on toxicological analyses. Introduction of this card into general service is expected to begin on 1 January 1977;

Blood - data from the Birmingham laboratory is still being added to the blood data file. The data bank now contains almost 3500 grouping records of control blood samples.

COMPUTER SERVICES

Organisation and Equipment

The year has seen little change in the organisation or equipment available to the section. Experimental terminal links to the Newcastle and Metropolitan Police Forensic Science Laboratories were however established. The links to both these laboratories proved technically effective. Despite much work by the staff of the Chorley laboratory an earlier project involving a link with that laboratory had to be abandoned because of difficulty with the quality of the telephone connection. An eight level to five level tape converter for turning computer compatible tape into telex compatible tape has been lent by Telecommunications Branch of the Home Office for evaluation. This is being used experimentally for direct transfer of computer search results to operational laboratories. All laboratories now have telex facilities which are used routinely for straightforward transfer of information.

Generally the maintenance duties of the section are increasing and the listing of information from the computer now runs into several hundred thousand of lines per year. This problem should be overcome with the addition of a line printer to the system in the very near future.

There has been a considerable increase in the consultation duties of the computer section both to other establishments and to other divisions of HOCRE.

Computer Services to HOCRE

The literature bank is increasing in size at the rate of about 2500 records a year and is, consequently, proving more and more useful. The bank of bibliographic data is being used for both author and title reference searching and to provide "current awareness" lists of all papers abstracted at HOCRE. The ATI system referred to earlier has required the writing of several experimental programs.

The year has seen the implementation of the system to deal with case reports involving vehicle paints submitted to HOCRE on optical mark cards. The file of data is now increasing rapidly in size. Programs have also been written to create a computer file for the Colin Tippet Collection of vehicle paint data. This system proved a big attraction when demonstrated recently at a conference for chief officers of police.

During the year a feasibility study on an automated firearms information retrieval system was carried out. The system was designed to identify the classes of 9mm and .38in selfloading weapons from fired bullets. The study showed that the retrieval system was technically feasible.

The two main services to Chemistry Division continue to be the maintenance of a structural search program (3172 records) and the provision of mass spectral data which were distributed in July (HOCRE Report 194). Several programs have also been written to assist with a Chemistry Division project involving estimation of time of death.

There has been a significant increase this year in requests for computer services from Drugs and Toxicology Division. Two main areas can be defined:

- (a) The processing of data from radioimmunoassay equipment;
- (b) The production of a system to search a file of TLC/GLC/UV data. This system was also designed to produce indices which have been used in the drug atlas distributed to the operational laboratories.

Work on the allergy systems referred to in the last annual report has continued.

Computer Services to the Operational Laboratories

No new programs have been devised during the year but the services referred to in the last report continue to be used. In particular the typescript file is used very frequently and in this context the tape converter referred to earlier has proved very useful.

EXTERNAL CONTRACTS

Suggestions for external contracts come from various sources, for example from scientists within HOCRE, from staff in the operational laboratories, from visiting lecturers or from outside companies. All suggestions go to the contracts section staff who ensure that the proposals are properly assessed. Ideas which show some promise become the subjects of feasibility studies and the advice of experts within the Forensic Science Service and other organisations is sought and collated before a recommendation is made to initiate a contract.

Whenever possible an operational laboratory scientist who is a specialist in a particular field is invited to assist in the technical supervision of a contract. In addition, the specialist committees are invited, where appropriate, to nominate a member to liaise with HOCRE and help with the supervision of a contract. A member of the contracts section is designated Contract Officer to co-ordinate the efforts of the contractor, the operational laboratory specialist, the specialist from HOCRE, the various committees and the Headquarters Forensic Science Service.

The contracts can be grouped under three main headings:

- (a) Instrument design and construction;
- (b) Research;
- (c) Data Collection.

Instrument Design and Construction Contracts

EC 25. The Construction of an Automatic Refractometer

The work on the automatic refractometer built by the Scientific Instruments Research Association is almost complete. During the year it was found that although the electronic circuitry of the equipment was satisfactory the optical arrangement was inadequate but further work to modify the optical system should be finished early in 1977 when the equipment will undergo laboratory trials.

EC 36 and EC 38. The Construction of Automated Diluters

The dilution stage of the analysis of blood samples collected from people suspected of driving with alcohol concentrations above the legal limit in their blood involved a tedious manual operation. It was decided, therefore, to design and build under contract an automated diluter to sample and dilute blood received from Road Traffic Act cases. Two engineering firms agreed to produce an instrument and one of these has been used successfully in operational laboratories.

The Hook and Tucker automated diluter shown in Figure 26 is designed to sample aliquots of blood from septum sealed containers and dispense the aliquot along with a suitable diluent into sealed bottles suitable for use in an automated gas chromatograph. The device is a twin turntable sampler. Viewed from the front the left hand turntable holds samples for dilution and the right hand table holds sealed analysis bottles. The sampler head accommodates two needles: a vent needle enters sample bottles before the sample needle and equilibrates them to atmospheric pressure. When the needles are out of the vials the two-way valve is electrically switched and any blood forced up the vent needle is sucked free when the pressure in the vials is released. The sampler head moves in two planes. It rotates about the central shaft into position over the vials and analysis bottles and lifts and dips to sample and dispense. After every

dilution step the sampler head stops between the two trays and the diluent is flushed through the sampler needle into a small sink. Thirty samples can be diluted in one batch. At the end of each batch operation an alarm is sounded and a flashing light indicates that the sampler is ready for further use. A report has been circulated (HOCRE Report 184).

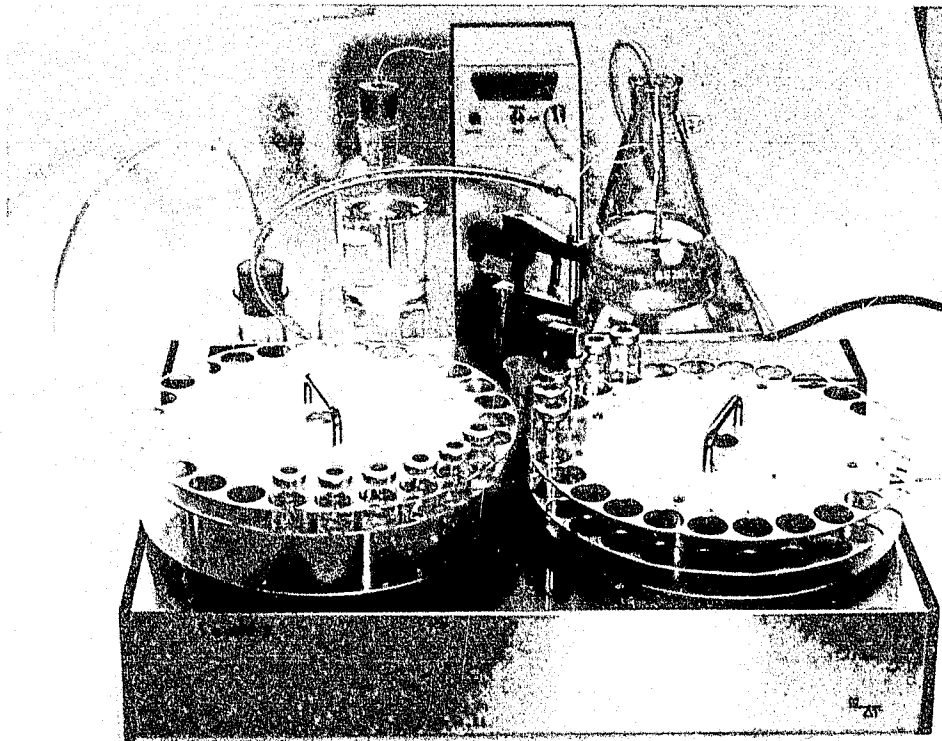


Figure 26: A Hook and Tucker Automated Diluter

EC 45. Construction of a Microcolorimeter

A contract with McCrone Research Associates to build a microcolorimeter to measure the colours of small paint chips and fibres is near to completion. It is based on the principle of an optically linked pair of microscopes using a single light source. To this has been added the Lovibond system of colour measurement which uses accurately graded glass colour filters and the colour matching abilities of the human eye. When the match is achieved the instrument gives an accurate measurement of the colour directly in Lovibond units, or, by the use of simple graphs, in the co-ordinates of the International CIE colour systems. We envisage that trials to evaluate the device will start in the Spring of 1977.

Research Contracts

EC 6. The Discrimination of Bloodstains by Analysis of Protein Levels

The contract with Loughborough University for work to improve the discrimination of bloodstains by the quantitation of specific proteins has been extended for a further year. In previous years, scientists at Loughborough have devised techniques for the accurate quantitation of bloodstain proteins and have studied a number of proteins to find those which are easily eluted from bloodstains, stable, and less variable in the individual than in the population. Blind trials are to be undertaken so that the techniques will have been thoroughly assessed before the work is presented to the operational laboratories as a viable method for discriminating bloodstains.

EC 40. The Production of an Anti-Red Cell Lysate Serum

The contract initiated last year with the Microbiological Research Establishment for the production of an anti-red cell lysate serum is continuing. At present, the operational laboratories have the choice of grouping a number of different enzymes occurring in bloodstains. Most of these enzymes require different conditions and different sets of expensive biochemical reagents for their detection. An anti-red cell lysate serum offers the possibility that the enzyme systems now used for discriminating between bloodstains can be detected simultaneously through the use of a single set of reagents. Such an antiserum could be used to aid the detection of other enzymes of value in discriminating between individuals. Batches of antiserum already received by HOCRE have been evaluated. The results show that the antisera produced are partially successful and further batches of antisera could be improved by antigen refinement for example the removal of haemoglobin from the red cell lysate.

EC 47. The Discrimination of Soil Samples by the Measurement of Enzyme Activity

A final report is expected soon on a recently completed contract with the Shirley Institute for the development of a method of comparing soil samples by the measurement of the activity of the various enzymes in soil. If this work has been successful, then further studies, including an extensive survey of soils from different sites, will be considered. The Shirley Institute have used an autoanalyser to study the activity of twelve enzymes in soil samples weighing 50mg-100mg. The reproducibility of the assay has been studied and the stability of the enzymes in wet and dried soil samples has been investigated. A small survey of soils from different sites has been carried out.

EC 48. The Examination of Human Hair by a range of Microscope Techniques

A contract has been placed with the Shirley Institute to examine human head hairs using a range of microscope techniques including polarising microscopy, interference microscopy, fluorescence microscopy and phase contrast microscopy. After examination the hairs are subjected to various chemical treatments or microbial attack and are re-examined microscopically to find any variation of properties in the hair from an individual. The work should be complete by April 1977.

EC 49. The Examination of Fibres in Swelling Agents

Some properties of fibres are being examined in another contract with the Shirley Institute. When fibres are immersed in certain liquids they absorb an amount of these liquids and increase in volume. The increased in volume can be assessed by the measurement of the increase in fibre diameter. Fibres of the same basic type (chemical nature and denier) may swell in a swelling agent to a significantly different extent. This may be due to one or a combination of the following factors:

- (a) they may originate from a different fibre manufacturer;
- (b) they may come from different batches of fibre;
- (c) they may have experienced different heat treatments

The Institute have suggested that the swelling characteristics of fibres may be useful to discriminate between fibres and they are developing a technique for the accurate measurement of the changes in dimension of single fibres. It is possible that the techniques could be used in a study of the effects of wear, laundering and ironing on swelling characteristics. Polyester fibres, nylon 66, nylon 6 and acrylic fibres will be studied and the contract should be completed in July 1977.

EC 42. An Investigation of the Genetic Basis of Salivary Proteins

An investigation of the various proteins present in saliva and their potential role in the identification of the individual has recently started at the Glasgow University Dental Hospital and School. In recent years the usefulness of isoenzymes has been established; saliva contains amylase isoenzymes and may contain other polymorphic proteins which could assist in discriminating between individuals. Scientists at Glasgow are using saliva and saliva stains to screen for genetically determined protein variants. Saliva from family groups is being included to assist in the determination of the genetic basis of inheritance of potentially useful proteins.

EC 46. The Preparation of Antibody Profiles from the Eluate from Human Bloodstains

Many of the antibodies produced by the body in response to a viral, bacterial or parasitic infection, or produced by an allergy, persist throughout life. These antibodies can be detected in small bloodstains by the use of rapid and simple techniques such as the fluorescent antibody technique. The preparation of an antibody profile from a bloodstain can be used to discriminate between individuals. The antibody profile gives information about a donor's age group, the presence of various allergies and vaccinations against various diseases. In previous years valuable research has been done at HOCRE into allergy, bacterial and parasite induced antibodies, but no work has been done on viral antibodies. The University of Glasgow, Department of Bacteriology has access to a large number of clinical blood samples and also has a large collection of viral

antigens. A programme of work which started recently with Glasgow University under contract is the preparation of antibody profiles from several thousand bloodstains from anonymous donors with known clinical histories. Profiles are being prepared using 15-20 different virus antibodies. The effects on bloodstains of substrate, storage and ageing are being studied and a method for the automation of part of the technique is to be attempted.

EC 51. A Study of Trace Elements in Hair using Proton Induced X-Ray Analysis

A previous contract with the Atomic Energy Research Establishment (AERE) Harwell using proton induced X-rays studied the distribution of trace elements across transverse sections of human hairs. The 3MeV proton beam can be focussed to 7µm x 15µm which makes the technique ideal for analysing small increments of material. Trace element distributions along the length of a hair reflect the diet, physiology and environment of an individual and a contract was initiated to see if the measurement of the trace element profile along a single human hair could help identify an individual. The first results are expected shortly.

EC 31. Detection of Toxic Metals in Blood, Urine, and Liver

An essential first step in the detection of toxic metals in blood, urine and liver tissue by atomic absorption spectrophotometry is the destruction of the matrix. Experiments have been performed where tetra-methyl ammonium hydroxide and mixtures of nitric, sulphuric and perchloric acids have been employed as the dissolving medias. Preliminary development has been carried out for the determination of Cu, Pb, Co, Mn, Cd, Ag, Cr, Ni, and Al in liver. An optimised multi-element extraction scheme has been developed for urine and Cu, Fe, Pb, Cd, Tl, Zn, Hg, Ni, and Co have been analysed this way. This contract has recently been completed and a full report is expected soon.

EC 41. The Histochemical Location of Drugs

A research project to investigate fluorescence microscope methods of drug detection was initiated last summer at Leeds University's Department of Forensic Medicine. The fluorescence properties of certain drugs have been known for some time, but this is believed to be the first attempt to employ this phenomenon as a basis for routine drug detection. During a post mortem examination drugs may be tentatively identified from the sequence of symptoms leading to death and by the observed damage they caused to the major organs, for example, staining and corrosion of the stomach by barbiturates. In other cases, such as paracetamol poisoning, the characteristic cell damage in certain tissues can only be recognised by microscopic examination. Many drugs do not cause characteristic symptoms and are present in the body at such low concentrations that routine detection is difficult. The detection of drugs and metabolites which have a visible autofluorescence could be achieved at macro and microscopic levels by illuminating the tissues with ultra-violet light. Other drugs, which are not usually found in the fluorescence condition can be made more susceptible by adjusting the acidity or alkalinity of the sample before examination and the resultant fluorescence from both groups of drugs would indicate their

presence. As localisation within tissues and the concentration of the drugs is proportional to their fluorescence a quantitative determination should be possible. The results from the work carried out in the first few months of this speculative project have shown some promise.

Data Collection Contracts

EC 19. Collection of Tyre Tread Patterns

In February Dunlop Limited produced a coding system for tyreprints which will assist in the retrieval of tyreprints with a particular tread pattern. As the coding of tyre prints is a formidable and time consuming task the coding of the 430 patterns distributed to operational forensic science laboratories this year (HOCRE Report 192) has not been completed. Dunlop Limited are now coding the collection and it is hoped that this will be finished shortly. Further updates of the collection will be distributed in the coming year.

EC 37. Collection of Boot and Shoe Sole Patterns

241 classified boot and shoe patterns produced by the Shoe and Allied Trades Research Association (SATRA) were distributed to the operational forensic science laboratories in August of this year (HOCRE Report 196). The contract is continuing next year to keep the collection up to date and further updates will follow.

EC 43. Drugs and Drug Metabolites: A Literature Survey

A contract initiated last year with Inveresk Research International (IRI) to carry out a comprehensive literature survey on the most commonly encountered drugs of abuse is now complete. The aim of the project was to carry out a survey of the scientific literature on the metabolic fate and the kinetics of absorption, distribution and excretion of 23 selected drugs together with their metabolites and to present the data in readily accessible form. In addition, samples of the major metabolites of the drugs have been collected.

Possible New Contract Areas

The staff of the contract section have actively been pursuing a number of new contract areas in recent months including:

- (a) The distribution of trace elements in glass other than window glass;
- (b) Leakage rates and deflated running of tyres;
- (c) An extension of the drug atlas;
- (d) The provision of a bank of animal serum samples from a large number of different species of animal;
- (e) A simplified 3 channel autoanalyser system to group liquid saliva and blood samples.

SPECIAL SERVICES

Crime Scene Studies on Glass

Crime scene studies on the size distribution and number of glass fragments transferred from smashed windows to a criminal have now been completed. Normal household windows of three different sizes were broken with either bricks or hammers. Fragments travelling in the opposite direction to the blow were collected on the floor which was covered with loose sheets of paper up to a distance of 3 metres from the window. Figure 27 shows the size distribution of glass on the clothing of individuals who stood near the smashed windows together with the data obtained from the survey work of Pearson et al (1971). Although

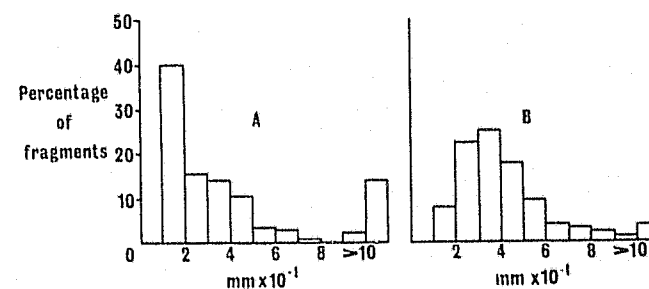


Figure 27: Size Distribution of glass fragments found on the clothing of individuals standing near a shattered window (A) compared to that found on clothing by Pearson et al (1971), (B)

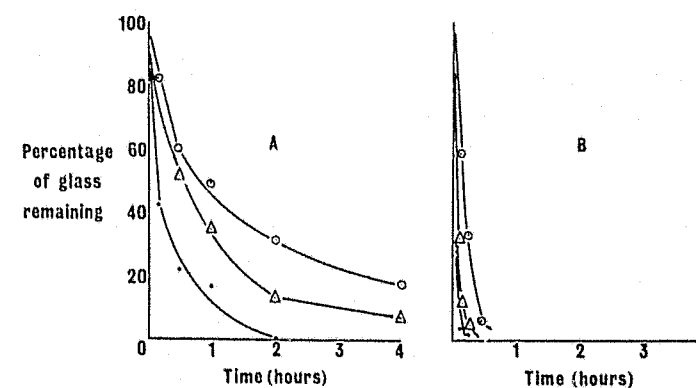


Figure 28: Persistence of glass fragments remaining on the surfaces of two articles of mens outer clothing
A = bulky sweater, B = fine sweater
O = 0.1 to 0.5mm, Δ = 0.5 to 1.0mm, . = > 1.0mm

many glass fragments hit individuals standing near a shattered window few appeared to be retained on clothing for any length of time. The persistence of glass fragments on the surface of five representative articles of men's outer clothing has been studied and the results for two garments are shown in Figure 28.

The rate at which the fragments were lost from the garment surfaces was very rapid. Persistence times were greater for coarse garments and small glass fragments. Details of the complete work done on the crime scene studies involving glass will appear shortly as HOCRE Reports 207 and 208.

Analysis Involving Neutron Activation

18 cases involving the analysis of arsenic in hair have been performed in the past year using neutron activation analysis. Three cases were positive and involved:

- (a) A fatal industrial accident where death was caused by the inhalation of arsine (evidence was given at a coroners court in this instance);
- (b) A seventeen year old school girl who attempted to commit suicide by taking a teaspoonful of arsenious oxide;
- (c) A women who survived after drinking a solution of sodium arsenite.

In all three cases the results obtained from the sectional analyses of hair enabled the dates of exposure to arsenic to be calculated. An experiment involving the monitoring of head and beard hairs over a period of months from a volunteer who had injected 6mg of arsenious oxide and submitted to periods in a climatic chamber have been completed and published (HOCRE Report 193).

Thorium levels were obtained by neutron activation analysis on post mortem samples of liver, kidney, spleen and lung from an old lady who had been injected with "Thorotrast" many years before death.

Colloquia

Since January 1976 the following colloquia have been held at Aldermaston in the William Penny Lecture theatre:

- (a) Fundamental Approaches to the Examination of Textile Fibres;
- (b) The Examination of Body Fluids other than blood;
- (c) Hair in Forensic Science;
- (d) Statistics in Forensic Science;

Details of these colloquia can be seen in Appendix F.

APPENDIX A LIST OF STAFF MEMBERS

Name and Division	Rank	Telephone Extensions
DIRECTOR		
Mr S S Kind	DCSO	5853, 4212
DEPUTY DIRECTOR		
Miss M Pereira	SPSO	5853, 4212
(Mrs P J Tew, Personal Secretary, 5853, 4212)		
BIOLOGY DIVISION		
Dr P H Whitehead	SPSO (IMP)	6951
Mr E R Rutter	PSO	5938
Mr J Sutton	SSO	6273
Mr M Davie	SSO	5937
Dr L A King	SSO	6273
Dr D J Werrett	HSO	5937
Mrs M J Dorrill	SO	5937
Mrs R Wigmore	SO	5937
Miss C M Bosley	ASO	5937
Mr R Burgess	ASO	5937
Dr J M Twibell	SRF	6273
CHEMISTRY DIVISION		
Mr K W Smalldon	PSO	5947
Dr M D G Dabbs	PSO	6951
Mr B German	SSO	5505
Dr R Dudley	SSO	5503
Dr J Locke	SSO	7574
Dr J D Twibell	SSO	6279
Dr R E Ardrey	SSO	5505
Dr R Macrae	HSO	5503
Mr C R Howden	HSO	5503
Mrs I B Beattie	SO	5505
Mr D R Boase	ASO	7574
Miss J M Home	ASO	6279

Name and Division	Rank	Telephone Extensions
-------------------	------	----------------------

DRUGS AND TOXICOLOGY DIVISION

Dr H M Stevens	SPSO(IMP)	5947/5938
Dr A C Moffat	PSO	5947
Dr A W Scaplehorn	PSO	6951
Mr P Gomm	SSO	5948
Dr P J Twitchett	SSO	6394
Dr S Fletcher	HSO	6275
Mr I J Humphreys	HSO	5948
Dr M D Osselton	HSO	5938
Dr P Owen	HSO	5938
Mr P L Williams	HSO	6394
Mr M D Hammond	SO	5938
Miss T M Holdstock	SO	5938

Dr A T Sullivan	SRF	6394
-----------------	-----	------

INFORMATION DIVISION

Dr E F Pearson	PSO	5947
Mr C Brown	SSO	5952
Dr R Holleyhead	SSO	5930/6733
Mr D S Loxley	SSO	5930
Mr C A Pounds	SSO	5930
Mr M Swain	SSO	6996
Dr A R Allan	HSO	6996
Mr G W Owen	HSO	4289
Mr J Porter	HSO	5952
Mr E M Besly	SO	6996
Mr M C D Harold	SO	6996
Mr B C Platt	ASO	4289

Mrs J H Gomersall	CA	6996
-------------------	----	------

ENGINEERING

Mr D J Nicholson	P&TO III	5783
------------------	----------	------

ADMINISTRATION

Miss M North	EO	5502
Mrs P Ridout	CO	5560
Miss H Payne	CO (Acting)	5942
Miss A E Livingstone	Audio Typist	5853
Miss A Mair	Audio Typist	5560
Miss P Hale	Typist	5942

Name and Division	Rank	Telephone Extensions
-------------------	------	----------------------

NON-TECHNICAL STAFF

Mr W F Hillen	Driver	6631
Mrs M M E Chapman	Cleaner	6631

SANDWICH COURSE STUDENTS

Mr C Offen		5505
Miss A Pendlebury		5938
Mr A Sedgwick		5937
Miss N Vasir		6273

APPENDIX B
CURRENT PROJECTS

The RP number refers to the Forensic Science Service Research Programme 1976/77

BIOLOGY DIVISION

Head of Division - Dr P H Whitehead

Title	Progress
<i>Discrimination Studies Using Non-Genetic Parameters</i>	
<u>Blood (RP 102)</u>	
Drugs	No other drugs detected in bloodstains since salicylate (HOCRE Report 107). In abeyance.
'Antibody Profiling'	Technique now established and shows considerable long term potential for gaining information from bloodstains relating to donors age, race, and clinical history (including allergy status) 'Blind trials' with operational laboratories completed successfully. Discrimination between UK and N-American citizens achieved using ragweed sensitivity. (HOCRE Reports 181, 197).
Clinical Biochemical Parameters	Completed. Limited value in Biochemical profiling at present (HOCRE Report 108).
<i>Discrimination Studies Using Genetic Parameters</i>	
<u>Semen (RP 85 86)</u>	
Acid Phosphatase	Analysis of 3 techniques for identifying seminal AP completed: Report in preparation. Quantitation of AP and other features (ABO, PGM, Sperm) ACROSS a stain initiated. 'Test-paper' for AP screening undergoing trials.
Other Semen Enzymes	New variants of PGM being investigated further by (1) family studies (2) blood-semen correlation studies. Improved overlay system for PGM described (HOCRE Report 205).

Saliva (RP 87)

Amylase Genetic variants	Further work by external contract.
Other Salivary Enzymes	To be started.
Other Genetic Markers	Km and Gm markers in saliva and semen detected, which offer new means of discrimination (HOCRE Report 155). Application to semen stains looks very promising (HOCRE Report 198). Blind trial initiated.

Blood (RP 88)

Studies on established enzyme variants	Anti sera to red cell enzymes being raised by external contract. Substitutes for o-tolidine described (HOCRE Reports 180 and 201).
Laurell electrophoresis	Protein work by external contract.

Immunology Studies

Use of Latex (RP 89 90)

Species identification of blood and tissue	Batches of latex evaluated and supplied to operational laboratories. Preparation on a larger scale planned by external contract.
Serology	Application to ABO antigens not yet successful.
Other antigens	To be started probably on Gm and Km systems initially.

General Studies (RP 87)

Amylase sensitive test paper	Amylase sensitive paper developed previously has shown wide distribution of saliva on 'normal clothes' (HOCRE Report 156). Effect of this saliva background on routine bloodstain grouping is under investigation. It has been shown possible to detect saliva under bloodstains (HOCRE Report 191).
"Elisa" studies (Enzyme linked immuno-sorbent assay; a new project)	More rapid child/adult discrimination. Wide potential in serology.

Correlation Studies (RP 91 92)

Technicon AutoAnalyzer for grouping in A, B and O systems simultaneously on liquid saliva in operation. (HOCRE Report 185). Effect of boiling on BGS studied (HOCRE Report 199) Saliva/ semen correlation studies started.

Automation (RP 92)

Blood grouping in ABH system

Automation of A,B,O grouping of blood-stains initiated. Kinetics being studied.

Hair

Sheath Cells (RP 103)

Problems encountered with sexing of sheath cells. Microscopic studies on frequency of occurrence of sheath cells show traditional views need revision (HOCRE Report 171). PGM and AP enzymes detected in root and sheath cells.

Keratin Studies (RP 5)

Electrophoretic studies of solubilised keratin proving difficult (HOCRE Report 204).

Sexing of Bloodstains
(New studies)

Chromosome studies

Difficulties encountered in reproducing earlier work. Advice from Wiesbaden (West Germany) being sought.

Hormone assay studies

In abeyance.

Time since Intercourse
(New Project)

Quantifying AP from stains and determining optimum extraction conditions. Investigations on swabs initiated.

CHEMISTRY DIVISION

Head of Division - Mr K W Smalldon

Title

Progress

Mass Spectrometry

Organic (MM 16F)

Thermogravimetric analysis
- mass spectrometry

Thermal analysis equipment installed and preliminary work started. Computer programs being written to allow continuous monitoring of products from closely related polymers.

Services for other
divisions

Ion monitoring used in the development of sensitive assays for THC (RP 60) and catecholamines (RP 73) in plasma. Collections of spectra for putrefaction acids (RP 76) and ergot alkaloids prepared in addition to standard spectra for drug data sheets. A number of samples from various projects in Toxicology and Drugs also examined.

Services for
operational laboratories

8 peak index now contains 1400 entries and co-operation with other countries beginning. Wiswesser collection updated to 4,000 compounds. 15 enquiries per month concerning difficult spectra and 7 cases dealt with for operational laboratories. (RP 107 108).

Inorganic (MS 702)

Trace elements in liver
tissue

Quantitative analysis for elements using photoplates and Autodensitator now fully developed. Study of 12 elements in 16 livers from drug overdose deaths showed good agreement with "normal" literature values. Full scale survey of normal livers to follow. Complementary and back-up analyses being developed mainly by atomic absorption. (RP 69)

Analysis of high purity and
ferrous metals

Project to begin during next year. Small survey of steels undertaken in connection with an operational case showed successful discrimination on microgram fragments.

Services for operational laboratories

Casework service continues to be offered particularly for the discrimination of glasses having similar physical properties, high purity or ferrous metals and trace elements in liver tissue on a limited basis. A full service for liver tissue will be made available next year.

Hair

Zinc levels in hair by FAA of value for some individuals but of limited value generally. Further detailed studies in progress using PIXA under external contract.

Services for operational laboratories

Use of atomic absorption, LMA1 and XRF in appropriate cases. Standard glasses and calibrated silicone fluids supplied for RI measurements.

Glass Paint and Fibrous Materials

Other Evidential Materials

Glass

FAAS method for iron and magnesium in 100µg fragments now well established. Survey of random breakages under way and reliable classification appears possible. XRF showing considerable promise for rapid multi-element classification of small fragments. ES not very successful quantitatively but qualitative method viable on small samples. (RP 17). Analysis and classification of glass fragments found on normal clothing to follow. Optical problems with automatic refractometer rectified on prototype instrument.

Explosives residues

Work in progress to achieve best system for swabbing hands. Transfer of explosive from sticks to hands studied, transfer of material from hands to secondary objects examined and from there to another person. Persistence of NG and EGDN determined on hands after handling explosives and after solution application.

Paint

Examination of single layered household paints and multilayered vehicle paints of similar microscopic appearance show XRF to have high discriminating power. Analysis of paint smears still providing difficulties. (RP 27). Multilayered white paints prepared from known samples and layer sequence not visible by normal microscopy. Flakes are mounted and stained with a reagent which reveals all the layers in most cases.

Gunshot residues

Detection of organic residues not successful. Screening method sought which will act as presumptive test prior to particulate analysis on SEM.

Motor body fillers

PGC and XRF being used to characterise body fillers. New method of standardising pyrograms being used. Samples from casework being analysed to determine frequency of occurrence of each type.

Fibres

Value of various methods for discriminating dyestuffs from wool fibres of similar colour being investigated. (RP 9). Methods for dyestuff extraction and TLC to be recommended shortly. Microspectrophotometry is producing very promising results and purchase of instrument appears justified. Details of trace elements found in various synthetic fibres collected but analysis normally worthwhile only for large samples. (RP 8).

Soil

Particle size distributions within silt and sand fractions found to be most discriminating soil parameters. Dry colour, ashed colour, density gradient columns and pH also found valuable. Simulated scenes of crime studied. Operational trials in progress. (RP 122)

Special Projects

Time of death

Multiple temperature measurements at several sites on body may provide better estimates. Computer routines for fitting cooling data being investigated together with cooling of simulated tissue.

Statistical interpretation

The evidential value of glass fragments found on clothing being assessed in those cases where a high proportion of fragments are present which are discriminable in physical properties from those at the scene of crime.

Vehicle collisions

A feasibility study is being undertaken to determine if micro and macro damage can be used to establish that two vehicles have been in contact.

DRUGS AND TOXICOLOGY DIVISION

Head of Division - Dr A Scaplehorn

Title	Progress
<i>Assays for Specific Drugs</i>	
LSD ² (RP 54 60)	Complete analytical procedure developed and in routine use for casework samples from operational laboratories. Studies undertaken on LSD metabolism in monkeys.
Insulin ² (RP 55)	Casework service provided. Ongoing research into measurement and interpretation of insulin levels in PM tissues.
Benzodiazepines ¹	A complete assay procedure based on enzymic tissue degradation and HPLC developed as well as colour and screening tests.
Cannabis ² (RP 56 60)	RIA, HPLC and GC/LMS assay procedures in use. Project underway to characterise cross-reacting metabolites.
Fluoroacetic Acid ¹ (RP 72)	An enzymic screening test developed and successfully used with poisoned animals.
Alcohol ² (RP 52 53)	Carbopack C column material evaluated. Breath alcohol devices tested as necessary.
Salbutamol ¹ (RP 73)	Assay developed.
<i>New Analytical Techniques and Procedures</i>	
HPLC ² (RP 59)	Assays developed for a wide range of drugs
RIA ² (RP 54 55 56)	Four drugs routinely assayed. Background information being collected.

- 1 Toxicology section project
- 2 Drugs section project
- 3 Drugs Intelligence laboratory project

Drug Release using Enzymes ¹	A procedure based on the use of the proteolytic enzyme subtilisin developed and shown to give increased yields of basic drugs compared with conventional methods.
Aupex ¹	External Contract evaluation - continuing development programme.
Action of Chloroform on Antidepressant Drugs ¹ (RP 75)	Eight drugs studied.
Stability of Drugs to Putrefaction ¹ (RP 76)	Four drugs studied.
<i>Collections of Analytical and Intelligence Information</i>	
Collection of Analytical Data for Drugs ² (RP 65)	100 data sheets circulated and more in preparation. Computer matching program developed.
Interfering acidic and neutral compounds of putrefaction ¹ (RP 76)	A further 9 acidic and 3 neutral compounds characterised.
Drugs Intelligence Laboratory ³ (RP 57 58 59)	Monitoring of drug abuse continuing, 245 samples received for further examination. Comparative studies of hash oil and amphetamine sulphate under way.

- 1 Toxicology section project
- 2 Drugs section project
- 3 Drugs Intelligence laboratory project

INFORMATION DIVISION

Head of Division - Dr E F Pearson

Function

The Division is concerned with the provision of scientific and technical information to assist with investigations in support of police enquiries. Duties in connection with external contracts have been added to the work of the Division this year and details of the projects involved are listed separately. The Division also deals with matters not specifically the responsibility of other Divisions at HOCRE. First enquiries should normally be to the Information Room, Telephone Tadley 3022 (STD Code 07356).

Information Section

- 1 Information and literature request service to operational forensic science laboratories, HOCRE and Home Office pathologists.
- 2 Checking of scientific literature for accession to computer literature system.
- 3 Current awareness circulation to forensic science laboratories.
- 4 Maintenance of HOCRE library facilities.
- 5 Editing and processing of HOCRE reports/publications.
- 6 Translation facilities.
- 7 Vehicle information: paint, headlamps, sidelamps, tyres, trim.

Data Collection and Quality Control Section

- 8 Quality control of FSL analytical work: alcohol standards.
- 9 Organisation and administration of interlaboratory trials.
- 10 Collection and collation of data from casework.
- 11 Research into subjective assessments and other matters.
- 12 Photography.

Computer Section

- 13 Maintenance of computer literature system and other systems.
- 14 Retrieval of information from computer systems.
- 15 Research into possible new systems.
- 16 Advisory rôle on matters connected with computers.

External Contracts Section

- 17 Biology.
- 18 Toxicology and Drugs.
- 19 Alcohol.
- 20 Chemistry.
- 21 General.

Special Services

- 22 Arsenic analysis.
- 23 Colloquia at HOCRE.
- 24 Attachments to HOCRE.
- 25 Scene of crime studies.

STAFF		FUNCTIONS
E F Pearson	PSO	Head of Division
M Swain	SSO	1-3, 5
C A Pounds	SSO	2, 18, 20, 21, 22-25
C Brown	SSO	2, 13-16
R Holleyhead	SSO	18, 19, 21
D S Loxley	SSO	17, 21
G W Owen	HSO	2, 8-12
J Porter	HSO	2, 7, 13
A R Allan	HSO	1, 2, 6, 22
M Harold	SO	1, 2, 4
E M Besly	SO	1, 2, 5, 6
B C Platt	ASO	2, 8, 10, 12
Mrs J Gommersall	CA	3, 4, 5

APPENDIX C

EXTERNAL CONTRACTS

RESEARCH CONTRACTS

Proteins in Bloodstains EC6

A project to improve the discrimination between bloodstains by measuring specific protein levels.

Anti-Rod Cell Lysozyme Serum EC40

This offers the possibility that a single set of reagents can be used to detect simultaneously the enzymes presently used for discriminating between bloodstains.

Enzymes in Soil EC47

A contract to develop a method of discriminating between soil samples by measuring the activity of various enzymes.

Microscopy of Head Hairs EC48

A project to examine head hairs by polarising, interference, fluorescence and phase contrast microscopy. Hairs are re-examined after chemical treatment to find lengthwise variation of an individual's hair.

Swelling of Fibres EC49

This may offer a way of discriminating between fibres of the same type. The fibres may swell in certain liquids to different extents due to a differing manufacturing process.

Salivary Proteins EC42

An investigation of proteins present in saliva to assess their usefulness in discrimination between individuals.

Antibody Profiling EC46

A method to discriminate between individuals by detecting antibodies in blood produced in response to an allergy or viral, bacterial and parasitic infections.

Trace Elements in Hair Measured by PIXA EC51

A contract designed to see if trace element profiles along single hairs offer a method of discrimination between individuals.

Toxic Metals in Urine and Liver EC31

Methods have been developed so that trace elements in urine and liver can be measured using atomic absorption spectrophotometry.

Drug Detection by Fluorescence Microscopy EC41

A project to see if it is possible to histologically locate and quantify drugs that exhibit autofluorescence, in post mortem tissue when irradiated with ultraviolet light.

DATA COLLECTION CONTRACTS

Tyre Tread Patterns EC19

A continuing contract to update the collection of tyres already held by the operational forensic science laboratories.

Shoeprints EC37

A continuing contract to update the collection of shoeprints already held by the operational laboratories.

Drug Literature Survey EC43

A contract to carry out a comprehensive literature survey of 23 of the most commonly encountered drugs of abuse.

INSTRUMENT DESIGN AND CONSTRUCTION CONTRACTS

Automatic Refractometer EC25

This equipment is being developed so that the refractive indices of samples of glass fragments can be measured automatically.

Automatic Diluters EC36 and EC38

Two diluters have been designed so that samples of blood in septum sealed containers can be automatically diluted into bottles for use with the F40 gas-chromatograph.

Microcolorimeter EC45

This equipment is being constructed to measure the colour of small paint chips and fibres.

APPENDIX D

HOCRE REPORTS PUBLISHED DURING 1976
(RESTRICTED CIRCULATION)

REPORT 180 January 1976
Substitutes for o-Tolidine and Similar Reagents for Use in the Detection of Haptoglobin Phenotypes

Various non-carcinogenic substitutes for o-tolidine have been tested for their ability to stain haptoglobin phenotypes following electrophoresis on polyacrylamide gels. Leucomalachite Green is recommended as a satisfactory alternative for the grouping of serum and bloodstains.

REPORT 181 January 1976
Allergy Profiles from Bloodstains: Report of an Inter-Laboratory Blind Trial

A blind trial has been carried out to extend the concept of "antibody profiling" of bloodstains. The Radio-allergo-sorbent test (RAST) was used to detect specific antibodies in bloodstains to pollen, house dust and cat epithelium. Hay fever, dust-mite allergy and cat hypersensitivity were successfully diagnosed from small (25µl) bloodstains.

REPORT 182 February 1976
The Fractionation of ABH Blood Group Substances in Saliva

Samples of saliva from secretors and non-secretors have been fractionated by gel permeation chromatography on Sephadex G100 and tested for blood group activity. Only one blood group active component of high molecular weight was detected and no further fractionation of saliva into lower molecular weight substances possessing blood group activity was found. The significance of these findings in relation to previously published work is discussed.

REPORT 183 April 1976
A Comparison of Graphitized carbon and polyethylene glycol as GC column packings for blood-alcohol analysis

The manufacture of the column packing Carbopack A coated with 0.4% Carbowax 1500 used for blood alcohol analysis has been discontinued and the report compares its performance with the replacement material Carbopack C coated with 0.2% Carbowax 1500. Relative retention times are given for a number of small molecular weight compounds on these two materials, on Porapak and on PEG-400.

REPORT 184 April 1976
Hook and Tucker (prototype) auto-diluter assessment
Confidential - internal circulation only

REPORT 185 June 1976

The Automated Assay of Blood Group Substances in Body Fluids

An instrument for the simultaneous measurement of A, B and H blood group substances in body fluids is described. Its use and relevance in forensic serology is discussed.

REPORT 186 June 1976

Refractive Index of glass - collation of frequency data

A collated computer output of RI data from glass samples examined by the operational forensic science laboratories.

REPORT 187 July 1976

Physical methods for the comparison of illicitly produced tablets

The report describes in detail the methods used for examining illicitly produced tablets in order to establish common sources of manufacture. The parameters of greatest value include descriptions and measurements of size, shape and colour, surface imperfections caused by incorrect formulation and damaged punches, and fine detail such as width, depth and angle of bevelled edges or breaklines.

REPORT 188 June 1976

Commercially available anti-species antisera from Hoechst UK Ltd

Eight commercially available anti-species antisera have been titred and tested for cross reactions against sera from ten species. The antisera were found to be of good quality and suitable for use in forensic serology.

REPORT 189 July 1976

Interaction between methadone and ether peroxides to produce 1,5-Dimethyl-3,3-Diphenyl-2-Ethylidene-Pyrrolidine the major cyclic metabolite of methadone

Report describes how methadone may be rapidly degraded during solvent extraction by peroxide impurities in the ether used. The product formed is identical to a known metabolite of methadone.

REPORT 190 July 1976

The persistence of Nitroglycerine and Ethylene Glycol Dinitrate on Hands

The persistence of nitroglycerine and ethylene glycol dinitrate has been studied on the palms of hands after application in solution and as a liquid film. When milligram quantities were initially applied to the hands ethylene glycol dinitrate could be detected for only a few hours and nitroglycerine for about sixteen hours. Washing once with soap and water removed about 70% of the nitroglycerine but subsequent washes appeared to have a reduced effect. It is suggested that evaporation is the most important mechanism of loss for short persistence times but that other mechanisms may become important after longer periods.

REPORT 191 July 1976

The detection of mixtures of blood and other body secretions in stains

The use of an amylase-sensitive test paper to detect saliva stains overlaid by bloodstains is described. The problems that may arise in case-work while ABO grouping of mixed blood/saliva stains are discussed.

REPORT 192 July 1976

Collection of full size British and foreign car tyre patterns and side wall lettering

A collection produced under an external contract with Dunlop Ltd.

REPORT 193 July 1976

Arsenic in Hair

This paper reports experiments to test a hypothesis as to whether arsenic is excreted from sweat into the hair. The results show that arsenic does not appear in distal ends of hair following a single dose.

REPORT 194 July 1976

An eight peak index of mass spectra compiled specifically for use in forensic science

The paper describes the 8 peak index of mass spectra which is held on computer at HOCRE. The options available for computer searching are detailed and a full index of 1260 spectra is provided for manual searching.

REPORT 195 August 1976

Coding and Computerisation of the Colin Tippett Motor Vehicle Paint Collection

This report describes how all the topcoat and undercoat colours introduced by British car manufacturers during the years 1961-75 have been coded and the data computerised. Examples show the efficiency of the system when used for the identification of motor vehicles from examination of paint flakes found at the scene.

REPORT 196/1 August 1976

Satra Shoeprint Collection: 1st Update, Part I

An up to date collection of British manufactured shoe sole prints.

REPORT 197 August 1976

Detection and Geographical Distribution of Ragweed-Specific Antibodies in Dried Blood

The geographical origin of an individual may be found by antibody profiling of bloodstains. The Radio-allergo-sorbent test was used in a blind trial to detect specific antibodies to Ragweed pollen, the main cause of hay fever in the United States. Of the bloodstains submitted,

24% were found to have antibodies to Ragweed pollen. In contrast, less than 1% of bloodstains submitted from residents of the United Kingdom had antibodies to this type of pollen.

REPORT 198 September 1976
Gm Typing of Semen and Saliva

The immunoglobulin markers Gm (1,2,3,5,10 and 14) and Km(1) have been discovered in liquid semen. Some of these markers are also detectable in semen stains. The potential of this new system in aiding the investigation of sexual offences is discussed.

REPORT 199 September 1976
A Quantitative Study of the Effect of Boiling on the Levels of the Blood Group Substances, A, B and H in Saliva

It is demonstrated that boiling saliva for 10 minutes makes no significant difference to the level of A, B and H substances, as determined by automated analysis.

REPORT 200 October 1976
A Study of the Analytical Reproducibility of Blood Alcohol Samples contained in vials which contain various combinations of Constituents

Confidential - internal circulation only

REPORT 201 October 1976
Presumptive tests for blood - a comparative survey

Various non-carcinogenic substitutes for o-tolidine have been tested for their performance in the presumptive test for blood. Tetramethyl benzidine was found to be the best substitute. However, this reagent is expensive and the Kastle-Meyer reagent or Leucomalachite Green, are recommended as cheaper alternatives.

REPORT 202 October 1976
The use of proteolytic enzymes in Benzodiazepine analysis from tissue

The report describes a method using the proteolytic enzyme subtilisin followed by solvent extraction and HPLC to determine benzodiazepines in liver tissue. The enzymic degradation shows significant improvements in drug recoveries compared with conventional procedures.

REPORT 203 October 1976
The use of a colour reagent for the detection and quantitation of the Benzodiazepines and their Benzophenone derivatives

The report describes how the well known Marquis reagent may be modified to enable the identification and quantitation of benzodiazepines and their benzophenone derivatives.

REPORT 204 November 1976
Extraction and Electrophoresis of hair proteins

The preparation of soluble extracts of hair proteins and their separation by electrophoresis is described. The results indicate that it may be possible to differentiate between hair from different animals but not between individuals of the same or closely related species.

REPORT 205 November 1976
A modified overlay system for the typing of semen based on the iso-enzymes of Phosphoglucomutase

An improved technique for developing phosphoglucomutase (PGM) isoenzymes in semen following starch gel electrophoresis is described. The relatively high levels of Zinc in semen inhibit PGM activity. It was found that this could be overcome by suitable chelating agents. The new technique is approximately 40% more sensitive for the PGM typing of semen than traditional methods.

REPORT 206 December 1976
The Analysis of Arsenic, Selenium and Mercury in Tissue and Urine Using a Commercial Sampling System

A Perkin-Elmer arsenic/selenium sampling system, an accessory for flame atomic absorption instruments, was assessed in a number of forensic applications including the analysis of urine and ashed liver samples. The As or Se in the sample was reduced to a volatile hydride which was discharged into the flame of a spectrophotometer.

The determination of Hg in human liver tissue was also made possible by making a simple adaptation to the apparatus to include a gas absorption cell.

Various alternative methods for converting the biological samples to suitable analytical solutions were also considered.

Reports of the Home Office Central Research Establishment are of restricted circulation. However, most of these reports appear subsequently in the scientific press. Details of the Home Office Central Research Establishment publication list can be obtained by writing to:-

The Director
Home Office
Central Research Establishment
Aldermaston
Reading
RG7 4PN

APPENDIX E

PAPERS PUBLISHED IN JOURNALS SINCE NOVEMBER 1975

- King, L A and Whitehead, P H
The Differentiation of an Adult's Bloodstain from That of a Child Using an Indirect Fluorescent Antibody Technique
 (Forensic Science, 1975, 6, 197)
 The published version of work described in HOCRE Reports 138 November 1974; 154 April 1975.
- Kipps, A E and Whitehead, P H
The Significance of Amylase in Forensic Investigations of Body Fluids
 (Forensic Science, 1975, 6, 137-114)
- Sutton, J and Whitehead, P H
Iso-Electric Focusing of Seminal, Faecal and Vaginal Acid Phosphatases
 (Forensic Science, 1975, 6, 109-114)
 The published version of work described in HOCRE Report 150 February 1975.
- Davie, M J and Kipps, A E
The Grouping of Saliva and Semen
 (Int Mic J of Leg Med, 1975, Vol 10, part 4)
 The published version of work described in HOCRE Report 155 April 1975.
- Whitehead, P H
Biological Research at CRE. New Information from Bloodstains
 (Police Research Bulletin, 1975, No 26)
- Burdett, P E, Kipps, A E and Whitehead, P H
A Rapid Technique for the Detection of Amylase Isoenzymes Using an Enzyme Sensitive "Test-Paper"
 (Biochemistry, 1976, 72, 315-319)
 The published version of work described in HOCRE Report 149 February 1975.
- Kipps, A E and Whitehead, P H
A Potential Screening Test for Elevated Serum Amylase Levels: Preliminary Communication
 (Ann Clin Biochem, 1976, 13, 361-363)
- Werrett, D J and King, L A
Allergy Profiles from Bloodstains
 (Clinical Allergy, 1976, 6, 75-77)
 The published version of work described in HOCRE Reports 162 July 1975; 181 January 1976.
- King, L A, Werrett, D J and Whitehead, P H
Antibody Profiling of Bloodstains
 (Forensic Science, 8, 1976, 151-154)
 The published version of work described in HOCRE Reports 114 January 1975; 138 November 1974; 184 April 1975; 161 July 1975; 162 July 1975; 181 January 1976; 197 August 1976.

- Werrett, D J, King, L A and Whitehead, P H
The Detection of Allergen-Associated Antibodies in Bloodstains
 (J Forens Sci Soc, 1976, 16, 121)
 The published version of work described in HOCRE Reports 162 July 1975; 181 January 1976.
- Kipps, A E, Rushton, C E and Whitehead, P H
The Detection of Saliva Stains Using an Amylase Sensitive Test Paper
 (Int Mic J of Leg Med, 1976, 11, part 1)
 The published version of work described in HOCRE Reports 120 March 1974; 144 November 1974; 145 January 1975; 178 October 1975.
- Whitehead, P H
The Radioallergosorbent Test
 (The Lancet, 1976, June 26)
- Davie, M J and Kipps, A E
Km (1) (Inv(1)) Typing of Saliva and Semen
 (Vox Sanguinis, 1976, 31, 363-367)
 The published version of work described in HOCRE Report 155 April 1975.
- Smalldon, K W
Chemical Research at CRE
 (Police Research Bulletin No 27, Summer 1976, 10)
- Dudley, R J
A Simple Method for Determining the pH of Small Soil Samples and its use in Forensic Science
 (J Forens Sci Soc, 1976, 16, 21)
 The published version of work described in HOCRE Report 151 March 1975.
- Dudley, R J
A Colorimetric Method for the Determination of Soil Saccharide Content and its Application in Forensic Science
 (Med Sci Law, 1976, 16, 226)
 The published version of work described in HOCRE Report 168 August 1975.
- Pearson, E F
Developments in Forensic Analysis
 (International Review of Science, Analytical Chemistry, Part 1; ed West, T S, Butterworth, 1976)
- Porter, J, Fouweather, C and May, R W
The Application of a Standard Colour Coding System to Paint in Forensic Science
 (J Forensic Sciences, 1976, 21(3), 629-635)
 The published version of work described in HOCRE Reports 85 April 1973; 86 April 1973.
- Landon, J and Moffat, A C
The Radioimmunoassay of Drugs
 (Analyst, 1976, 101, 225-243)

Twitchett, P J, Gorvin, A E P and Moffat, A C
High Pressure Liquid Chromatography of Drugs II. An Evaluation of a Microparticulate Cation-exchange Column
(J Chromatogr 1976, 120, 359-368)
The published version of the work described in CRE Report 179 October 1975.

Twitchett, P J, Gorvin, A E P, Moffat, A C, Williams, P L and Sullivan, A T
An Evaluation of some HPLC Columns for the Identification and Quantitation of Drugs and Metabolites
(High Pressure Liquid Chromatography in Clinical Chemistry, Editors, Dixon, P F, Gray, C H, Lim C K and Stoll, M S. Academic Press London, 201-209)
The published version of the work described in HOCRE Report 158 March 1975; 179 October 1975

Stevens, H M, Moffat, A C and Drayton J
The Rapid Identification and Quantitation of Fluoroacetamide and Fluoroacetic acid in biological Materials
(Forensic Science 1976, 8, 131-137)
The published version of the work described in HOCRE Report 172 October 1975

PAPERS IN PRESS

Burdett, P E and Whitehead, P H
The Simultaneous Separation of the Phenotypes of PGM, EAP and Haemoglobin using Iso-Electric Focusing
(Anal Biochem)

Quarmby, V and Whitehead, P H
The Significance of Hair Sheath Cells
(J Forens Sci Soc)
The published version of work described in HOCRE Report 171 October 1975.

Rutter, E R and Whitehead, P H
The Fractionation of ABH Blood Group Substances in Saliva
(J Forens Sci Soc)
The published version of work described in HOCRE Report 182 February 1976.

German, G, Morgans, D, Butterworth, A and Scaplehorn, A W
A Survey of British Container Glass Using Spark Source Mass Spectrometry with Electrical Detection
(J Forens Sci Soc)
The published version of work described in HOCRE Report 93 May 1973.

Howden, C R, German, B and Smalldon, K W
The Determination of Iron and Magnesium in Small Glass Fragments Using Flameless Atomic Absorption Spectrophotometry
(J Forens Sci Soc)
The published version of work described in HOCRE Report 176 December 1975.

Gomm, P J and Humphreys, I J
Physical Methods for the Comparison of Illicitly Produced Tablets
(J Forens Sci Soc)
The published version of the work described in HOCRE Report 187 July 1976.

Ardrey, R E and Brown, C
The Identification of Organic Compounds Using Spectroscopic Interpretation and a Computer Bank of Molecular Structures stored in the Form of their Wiswesser Line Notations
(J Forens Sci Soc)
The published version of work described in HOCRE Reports 157 May 1975; 169 September 1975.

Dudley, R J
The Particle Size Analysis of Soils and its use in Forensic Science: The Determination of Particle-Size Distributions within the Silt and Sand Fractions
(J Forens Sci Soc)
The published version of work described in HOCRE Report 152 March 1975.

Dudley, R J
The Use of Cathodoluminescence in the Identification of Soil Minerals
(J Soil Sci)
The published version of work described in HOCRE Report 163 July 1975.

Whitehead, P H
Crossed Electroimmunodiffusion and Bloodstain Investigations
(Science)

Kind, S S and Owen, G W
The Assessment of Information Content gained from Microscopical Comparison of Hair Samples
(J Forens Sci Soc)

Moffat, A C
Absorption of Drugs
(Drug Metabolism in Man; Editor, Gorrod, J. Pharmaceutical Press)

Moffat, A C
Gas Liquid Chromatographic Methods for the Analysis of Drugs and their Metabolites
(Proc Analyt Div Chem Soc)

Ratcliffe, W A, Fletcher, S M, Moffat, A C, Ratcliffe, J G, Hosland, W A, Levitt, T E
Radioimmunoassay of Lysergic Acid Diethylamide (LSD) in Serum and Urine using Antisera of Different Specificities
(Clin Chem)

Stevens, H M, Owen, P and Bunker, V W
The Release of Alkaloids from Body Tissues by Protein Precipitating Reagents
(J Forens Sci Soc)
The published version of the work described in HOCRE Report 165 September 1975)

Osselton, M D, Hammond, M D and Twitchett, P J
The Extraction and Analysis of Benzodiazepines in Tissues by Enzyme Digestion and High Performance Liquid Chromatography
(J Pharm Pharmacol)
The published version of the work described in HOCRE Report 202 October 1976.

APPENDIX F

COLLOQUIA

Interested readers may write direct to the HOCRE and letters
will be forwarded to the relevant speakers

----- oOo -----

FUNDAMENTAL APPROACHES TO THE EXAMINATION OF TEXTILE FIBRES

Friday, 9 January 1976

Chairman Mr P G W Cobb

Fibre mounting media

Mr D Norton - Metropolitan Police Laboratory

A procedure for the comparison and identification of fibre micro
samples

Mr R Cook - Metropolitan Police Laboratory

The Transference of fibres between clothing materials and their
persistence during wear

Mr C A Pounds - Central Research Establishment

The collection of fibre statistics

Mr K W Smalldon - Central Research Establishment

Investigation of breaking of fibres by SEM

Mr J Dubery - Birmingham Forensic Science Laboratory

SEM of charred fibres and trace element analysis

Mr R Keeley - Metropolitan Police Laboratory

Some fibre case studies

Dr N T Weston - Birmingham Forensic Science Laboratory

THE EXAMINATION OF BODY FLUIDS OTHER THAN BLOOD

Friday, 6 February, 1976

Chairman Mr J L Fish

Research problems related to semen

Prof T Mann FRS - University of Cambridge

Gm grouping of semen

Dr Ann E Kipps- Central Research Establishment

A re-appraisal of the Lugol's iodine technique for the identification
of vaginal epithelial cells

Dr T Rothwell - Aldermaston Forensic Science Laboratory

The viability of saliva samples

Miss R Biggs - Birmingham Forensic Science Laboratory

The quantitative assay of blood group substances in saliva

Dr P H Whitehead and Mr M J Davie - Central Research Establishment

The evaluation of results obtained from tests on vaginal, anal and
oral swabs

Mrs Anne Stedman - Metropolitan Police Laboratory

Examination of urine stains

Mr C Price - Metropolitan Police Laboratory

CONTINUED

1 OF 2

HAIR IN FORENSIC SCIENCE

Friday, 5 March, 1976

Chairman Mr S S Kind

The scanning electron microscopy of Human Hair
Dr J A Swift - Unilever

The keratin protein-complex: A review of the present position
Dr J C Fletcher - Wool Industries Research Association

Presentation to Mr E G Davies

Differential thermal analysis and thermogravimetry of wools and
hairs
Dr J S Crighton - University of Bradford

Measurement of trace element distribution across the diameter of
human hair using proton induced x-ray analysis
Dr J A Cookson - AERE Harwell

Current thoughts on the blood grouping of hair
Mr P Martin - Metropolitan Police Laboratory

STATISTICS IN FORENSIC SCIENCE

Friday, 2 April, 1976

Chairman Mr R M Mitchell

The Interpretation of Scientific Evidence
Mr I W Evett - Birmingham Forensic Science Laboratory

Some Uses and Abuses of Statistical Methods in Forensic Science
Mr K W Smalldon and Dr R J Dudley - Central Research Establishment

An Evaluation of Blood Stain Evidence in Forensic Casework
Examination
Dr T Rothwell - Cardiff Forensic Science Laboratory

The Use of Forensic Statistics by the United States Air Force
Office of Special Investigations
Captain M A Thomson - United States Air Force

The Classification of Handwritten Numerals
Mr M Ansell - Metropolitan Police Laboratory

ACKNOWLEDGEMENTS

Mr E G Wise and Mr K T Evans of the Ministry of Defence, Atomic Weapons Research Establishment gave advice on presentation. Brian Platt prepared the photographs. Gary Owen and Dave Loxley planned the lay out. Anne Livingstone typed the final version. Ed Besly and Rob Macrae debugged the English.

----- oOo -----

END