Home Office

Police Scientific Development Branch

Crime Investigation and Officer Safety Sector

Fingerprint Development and Imaging Newsletter

October 2004 Publication No. 71/04

In this issue –

This is the second publication of the PSDB Fingerprint Development and Imaging Newsletter of 2004. We regularly receive and seek feedback on the publication and it appears that some personnel may have limited access to copies. While not all interested parties have access to the internet, for those that do we will shortly be making the current edition and earlier Newsletters available on the PSDB website in pdf format, accessed via www.psdb.gov.uk

Operational Support

A large part of our programme of work is allocated to the provision of operational support to police forces. Since April we have been monitoring the extent of this contact, which might be by telephone, e-mail or in person, either at PSDB or at force premises.

The objective was to establish whether there were common issues which might be rectified by better communication or by conducting pieces of work to investigate particular issues.

A review of the period between April and June shows that we made contact with two-thirds of UK forces and some outside the UK, from making direct contributions to casework to suggesting research topics for visiting students.

We welcome this contact and the following item has been included as a direct result.

A Brief History of Fingerprint Development Techniques : Now and Then

Several police forces have contacted PSDB recently for advice regarding cold case reviews, asking which development techniques have become available since the last review. Below is an attempt at a potted history.

Timeline

19th Century	Visual Examination, Powders and
1954	Ninhydrin in acetone formulation
1950s	Aluminium Powder and glass fibre brushes
1970	Methanol-based Amido Black
1974	CFC-based Ninhydrin
1975	Vacuum Metal Deposition
1978	Small Particle Reagent dish-application.
1979	Gentian Violet
1980	Gentian Violet transfer technique
1981	Physical Developer
1981	Small Particle Reagent spray-application
1983	Maleic Acid prewash for Physical Developer
1984	Quaser light sources for Fluorescence Examination
1985	Sudan Black
1986	Sandridge Superglue Cabinet
1987	Basic Yellow 40 dyeing for Superglue
1989	Water-based Amido Black
1990	Temperature and humidity optimised for ninhydrin development
1992	DFO
1998	HFE-based Ninydrin
2001	HFE-based DFO
2002	SUPERfume®
2004	Water-based Basic Red 14 for dyeing superglue at scenes of crime
2004	Water/ethanol/acetic acid based Acid Black 1 (amido black) replacement for previous formulations
2004	Acid Violet 17 and Acid Yellow 7

Visual Examination, Powders and Iodine have all been practised since the 19th Century, although the introduction of aluminium powder used with glass fibre brushes in the 1950s proved to be a great leap forward in effectiveness.

Ninhydrin, discovered in 1910 by Siegfried Ruhemann, was first used for fingerprint development in 1954 by Oden using a formulation based on acetone. Since then there have been many changes to the formulation and conditions, most notably in 1974 when Morris and Goode, under contract to PSDB, developed the use of CFC113 in place of acetone as the carrier solvent. In 1990 Sears and Kent (PSDB) worked with Gallenkamp to develop a humidity oven capable of giving reproducible conditions of 80°C and 68% relative humidity. In 1998 Sears and Hewlett developed the HFE formulation currently recommended.

Amido Black, now referred to as Acid Black 1 to avoid confusion, was first used in 1970 by Leiber to develop fingerprints on brass. Leiber's methanolic formulation continued to be used for enhancement of fingerprints in blood alongside a water-based variant, introduced in 1989 by Hussain and Pounds. These formulations are shortly to be replaced (see p10 'Publications') by water-ethanol-acetic acid formulations of acid black 1 and two other dyes (acid violet 17 and acid yellow 7) developed at PSDB by Sears, Butcher, Fitzgerald and Prizeman.

In the early and mid 1970s Vacuum Metal Deposition was developed by Kent, Thomas and others at PSDB. The equipment was originally based on modified industrial vacuum coaters but more recently coaters have been specifically developed for fingerprint development.

Small Particle Reagent, dish-application, was developed in 1978 by Morris and Wells under contract to PSDB. A less effective spray application for use at scenes of crime was introduced in 1981 by Pounds and Jones of the FSS.

In 1979 Kent (PSDB) introduced a phenolic formulation of Gentian Violet (basic violet 3) for use on adhesive tapes. This was improved in 1980 when Kent added a transfer method for use on black tapes.

Physical Developer was developed for fingerprint use by Fuller (under contract to PSDB) in 1974/5 and this was introduced for police use in 1981 by Hardwick (PSDB). A Maleic Acid prewash for filled papers was added in 1983 by Hardwick and Sears.

Fluorescence Examination was introduced to police forces with the production of the Quaser light sources in 1984/5 by Mason Vactron, from designs by Kent, Hardwick and Sears (PSDB). Since then a family of Quasers has been developed and the process was formalised in PSDB's publication, Fingerprint Detection by Fluorescence Examination.

Originally developed in Japan, Sudan Black (solvent black 3) was modified and then introduced to the UK in 1985 by Pounds of the FSS.

The discovery of the interesting properties of Superglue to develop fingerprints dates back to the late 1970s and is claimed by many in various countries. However Laurie Wood and his colleagues at Northamptonshire Police brought it to the attention of the Home Office. This was commercialised in the early 1980s by a variety of companies producing cabinets, pads, special glues and wands. However, it was in 1986 that Kent, Hardwick, Murray and Sears (PSDB) produced the specification for the Sandridge Superglue Cabinet manufactured by Mason Vactron, which prescribed the optimum conditions for development.

An early attempt at the superglue technique (artist unknown)

A dyeing process, using Basic Yellow 40, introduced by Sears in 1987, enabled improved visualisation following superglue treatment. In 2002 Mason Vactron introduced the SUPERFume® equipment to carry out superglue for use at scenes of crime.

Basic Red 14, a new water-based superglue dye for safe use at scenes is introduced in this Newsletter by Sears and Fitzgerald.

A novel use of DFO was proposed by Grigg (under contract to the FSS) in 1989/90. This was optimized for police use by Sears and Winfield (PSDB) and introduced in 1992. The HFE formulation developed by Sears and Hewlett was introduced in 2001.

One technique that remains elusive : coloured or fluorescent Superglue

Since the early 1980s, when superglue was first used to develop fingerprints there has been a desire for a coloured or fluorescent product to remove the need for a dual process.

We are frequently asked why this development has not been made available, especially given the frequency with which the superglue technique is used. Major problems arise because the addition of a chromophore either makes the cyanoacrylate monomer too large to evaporate at a reasonable temperature or the chemical bond proves unstable at elevated temperatures.

Many companies, including 3M and Loctite, universities in the USA, UK, Germany and Israel, have spent much time and effort trying to modify the cyanoacrylate so that it would demonstrate colour or fluorescence. All attempts to date have failed.

Latest Release :

A New Water-Based Dye For Superglue – Basic Red 14

The currently recommended water-based formulation of Basic Yellow 40 (BY40) has an

inferior performance to the ethanol-based formulation. Fluorescence is 3-4 photographic stops (an eighth to a sixteenth) less brilliant and longer treatment time is required. Since PSDB recommends that only the water-based BY40 is used at scenes for health and safety reasons, the Superglue process is consequently less effective at scenes of crime than in the laboratory. With its increasing use at scenes, PSDB undertook a project with the objective of improving the effectiveness of superglue dyeing in this application. Two approaches were taken: to improve the performance of the currently recommended water-based BY 40 or seek an alternative dye with similar advantages.

An alternative was found: a water-based formulation of Basic-Red 14 (BR14) gave fluorescence that was 2 photographic stops brighter than the water-based BY40.

However, this water-based formulation MUST NOT BE USED as a replacement for the ethanol-based BY40 in the laboratory as it yields fluorescence 1 photographic stop less brilliant and is only stable for a few hours.

In advance of publication of the method in the Manual of Fingerprint Development Techniques at a future date, the instructions for preparation and use of WATER-BASED BASIC RED 14 are as follows:

Health & Safety Information

BASIC RED 14 is an IRRITANT.

LEVERCET CARRIER ACC is an IRRITANT.

Treatment of Surfaces and Large Articles with Water-Based BR14

1. In important cases ensure that photographs have been taken of fingerprints already visible before beginning treatment.

N.B. Some vinyls and rubbers may take up large amounts of fluorescent dye in the background, producing very high background fluorescence, obscuring developed fingerprints.

2. Ensure there is sufficient WATER-BASED BR14 WORKING SOLUTION and TAP WATER in garden spray units to treat and rinse the surfaces of the articles to be treated.

3.. Spray surfaces with WATER-BASED BR14 WORKING SOLUTION, ensuring that surfaces stay 'wet' for approximately 1 minute.

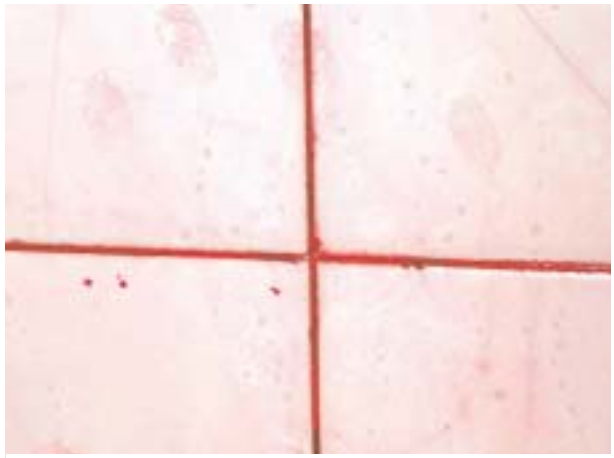
Spraying BR14 after Superglue

4. Spray surfaces with TAP WATER until excess dye has been removed from the background.

5. Allow surfaces to dry at room temperature.

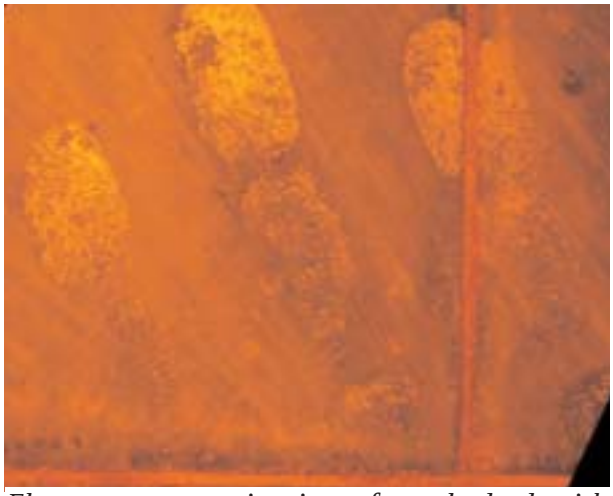
6. Photograph useful fingerprints.

N.B. Use of fluorescent dyes occasionally improves contrast for conventional photography but FLUORESCENCE EXAMINATION is usually required.



Dyed marks after washing

7. Carry out FLUORESCENCE EXAMINATION using Quaser 473-548nm excitation with 549nm viewing glass.



Fluorescence examination of mark dyed with BR14

Preparation of Water-Based BR14 Working Solution

1. Shake the BR14 CONCENTRATED SOLUTION well and immediately pour into a plastic 5 litre bottle, ensuring that any solid is also transferred to the bottle.

2. Measure out 5 litres of TAP WATER. Add this to the BR14 CONCENTRATED SOLUTION and shake well. A BR14 WORKING SOLUTION will be produced. This must be used immediately

N.B. The WATER-BASED BR14 WORKING SOLUTION will only keep for 1-2 hours.

Preparation of Water-Based BR14 Concentrated Solution

1. Weigh out 5g of BASIC RED 14. Place in a clean, dry 250ml glass beaker.

2. Measure out 50ml of LEVERCET CARRIER ACC and add to the beaker whilst stirring with a magnetic stirrer. A slurry will be produced.

3. Measure out 50ml of DISTILLED WATER and add to the slurry. Stir for at least 30 minutes. A dark red BR14 CONCENTRATED SOLUTION will be produced.

4. Transfer BR14 CONCENTRATED SOLUTION into a clean, dry 250ml plastic-coated, clear glass bottle with a well-fitting screw top and label to include the date. Store in a cupboard.

N.B. The BR14 CONCENTRATED SOLUTION will keep for at least 3 months at normal room temperature.

Suppliers

Basic Red14 dye and Levercet Carrier ACC are available from:

Keystone Europe Ltd.
Units 1-2 Beckview Business Park,
Bradley Junction Industrial Estate.
Leeds Road
Huddersfield HD2 1UR.
(01484) 341 466.

CURRENT PROGRAMME OF WORK

Fingerprint Powder Survey of UK Police Forces

Another area of work where direct contact with forces has proved invaluable is in connection with the project looking at the use of powdering techniques for fingerprint development.

The results will be published as a series of studies: forces should have received the results of the first study (see p10 of this publication) which looked at the use of a variety of brushes with aluminium powder.

In order to progress this project, PSDB has recently conducted a large survey of scene examiners and procurement staff. The aim of the survey was to establish which powders, applicators and lifting media UK scene examiners are currently using and for which surfaces. The information will help us to establish the most appropriate powders, applicators and lifting media on which to base our subsequent studies.

208 responses were received from scene examiners from 29 police forces.

PSDB would like to thank all those who took part and would ask readers to pass on our thanks to participants of the survey who might not receive this newsletter.

Comparison of Superglue and Powders

While the next phase of the powders project is at the planning stage, work is continuing to compare the results obtained with superglue and powders on particular surfaces. Earlier work (SUPERFume® report : Home Office Publication 30/03) indicated that powdering yielded at least as many marks on most surfaces when compared with superglue., with some exceptions. These are textured surfaces, where the superglue technique outperformed powdering.
PSDB is extending this study with particular reference to the supergluing of cars.

Operational Trial of New Adhesive Tape Techniques

Surrey, Thames Valley and West Yorkshire are continuing their trial to evaluate three new techniques for the development of fingerprints on adhesive tapes. Avon and Somerset have joined the trial in order to accelerate the generation of results, which are currently looking promising.

Tayside Police have also used one of the techniques in casework and successfully developed additional marks on black tape.

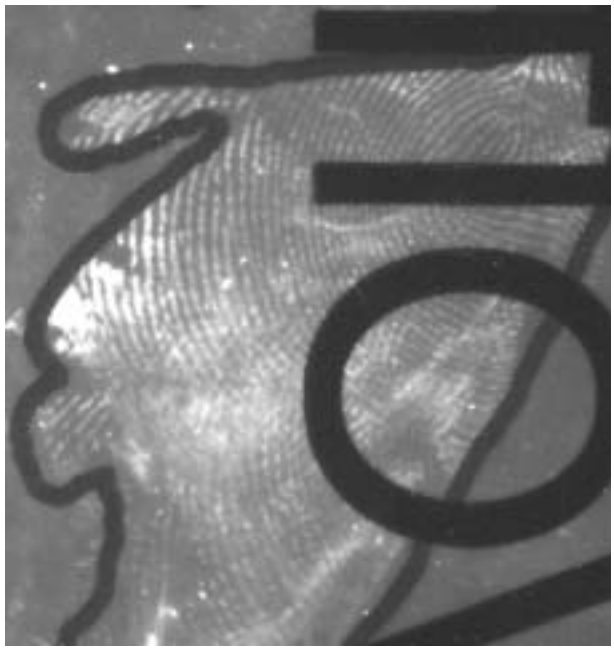
Trial of New Lipid Dyes

Laboratory development of a less flammable Sudan Black formulation for use at scenes is looking promising on clean surfaces. Attempts to generate suitably contaminated surfaces in the laboratory have proved so difficult that we are planning to test the formulations in pseudo-operational conditions using empty flats kindly made available for our use prior to complete refurbishment by the Housing Association which owns them.

Fluorescence Examination with a Nd:YAG Laser

Fluorescence examination of untreated surfaces is generally less productive than other techniques and can be very time consuming. However, it may visualise marks that would otherwise not be detected by other methods. Currently, most initial fluorescent examinations use a high intensity light source (usually metal halide or xenon arc bulbs) with a range of band-pass excitation filters and appropriate viewing filters with output powers ranging from a few 10s of mWatts to several Watts.

Mark illuminated with a Q100



Mark illuminated with Nd:YAG laser

PSDB is conducting a feasibility study to look at the effectiveness of a Nd:YAG laser for such searches. The system operates at 532 nm (green) and can have an output power of 5-10

Watts. As well as the extra power, the laser may produce less background fluorescence on some surfaces. Both of these properties should assist in the detection of weaker marks. The results of small initial tests indicate that the system can find more marks on some surfaces than a Quaser 100.

While the current costs may deter many forces from considering the purchase of a laser, it should be borne in mind that costs are likely to decrease with increasing interest. Mobile units, with appropriate safety measures, would be eminently suitable for searching scenes of serious crimes.

Fingerprint Retrieval from Arson Scenes

The retrieval of fingerprints from arson scenes is a subject of growing interest. Although the damage caused by smoke, fire and the water used to extinguish the fire may appear to preclude the survival of any evidence, there have been cases where useful marks have been recovered. In the last couple of years, work by Jack Deans of Gardiner Associates has demonstrated that marks can actually survive on a wide range of articles, even those that may initially appear too badly damaged to retain any evidence.

PSDB has therefore initiated a feasibility study to investigate this further. The objectives of the work are to provide preliminary answers to the following questions:

- Can marks survive?
- On which surfaces and in what locations are marks most likely to survive?
- What are the best processes for soot removal?
- What are the best processes to develop marks on articles exposed to fire and soot?

Working in collaboration with Jack Deans, the study has involved placing depletion series of marks from several donors on substrates representative of household surfaces, including painted door panels, ceramic tiles, aluminium sheets, wallpaper on plasterboard and glass bottles. These surfaces have been placed into fire scenes at the Gardiner Associates facility at MDP Wethersfield, placing samples so that each surface was exposed to a variety of conditions ranging from close to the seat of fire and exposed, to more protected locations under furniture.

Articles exposed to a fire scenario at Wethersfield

After the fires had been extinguished, the samples were recovered and treated in the laboratory, to investigate the effectiveness of both soot removal techniques and of existing fingerprint development techniques.

In parallel with this work, laboratory studies have been conducted to investigate the effects of temperature and exposure time on the survival of marks. Ceramic tiles, aluminium sheets, paper, painted door panels and smooth melamine panels have had depletion series of fingerprints deposited on them, followed by exposure to temperatures in the range 100 - 500°C for periods up to 8 hours. The surfaces have then been treated using a variety of techniques from the Manual of Fingerprint Development Techniques.

The results to date have been encouraging, the laboratory experiments showing that although the number of marks developed does decrease with increasing exposure temperature and exposure time, marks can still survive and be developed after exposure

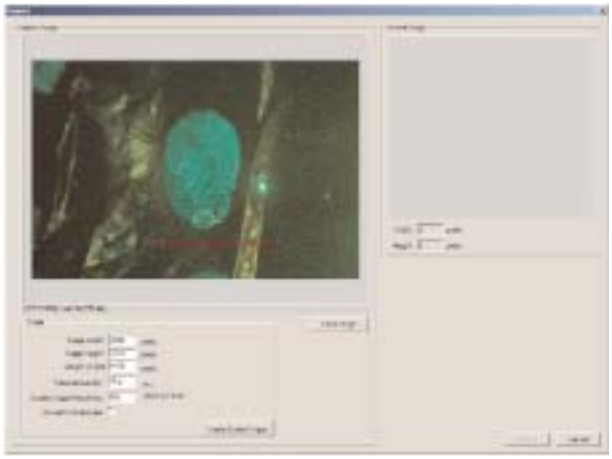
at 400°C for 7 hours. This has been supported by the results of the tests at Wethersfield, where marks have been developed on surfaces recovered from close to the seat of fire. Initial observations have indicated that the best development techniques are powders and powder suspensions (e.g. Small Particle Reagent) for non-porous surfaces, and Physical Developer for porous surfaces. Various techniques for removing soot have also been investigated, including lifting tape, latex, and dry sponges. Some of these may have potential for future use.

The results of the feasibility study will be presented to the User Group in October, where a decision will be made on the future direction of the research. In the meantime, any forces who would like further information on the current study are welcome to contact PSDB.

IRIS Support

The number of IRIS workstations in use continues to grow, with nine systems now operational and a further three scheduled for delivery before the issue of this Newsletter. The workstations are proving capable of imaging in excess of 100 marks per day, and in some forces over 10,000 images are now stored. The two IRIS loan systems also continue to prove popular ; by the time this Newsletter is published ten forces, two forensic service providers and Centrex will have had access to a loan system, either for technology evaluation or for the reduction of backlogs.

A version of the software with a facility for inputting images from scene of crime cameras is being tested at two forces, and feedback from this trial being incorporated into the final software version. The software allows input of scene of crime images via a flashcard reader or from a CD, allowing the user to re-scale the picture to a 1:1 monochrome image at 500 pixels per inch resolution. The metadata from the scene of crime camera is embedded into the data fields associated with the image to enable an audit trail to be maintained. Images have been successfully transferred into IRIS from a range of cameras, including the Nikon D1X, Nikon D100 and Canon EOS D10. The software is currently being revised to allow it to read RAW files from Canon, Kodak and Nikon cameras.



The 'Import Image' window for IRIS Imager, allowing re-scaling and monochrome conversion of Scene of Crime images

The IRIS software functionality is also being upgraded to allow barcode readers to be used to input data fields and to reprint the barcode within the image. This will enable users of evidence tracking systems such as Socrates and Locard to input filenames and evidence identifiers without the risk of mis-typing, and also to retain the barcode identifier with the image.

In order to provide a forum for the capture and exchange of ideas, PSDB would like to propose the formation of an IRIS User Group. The initial stages of the process have already been set in motion with a User Questionnaire issued to existing users, and the feedback from these questionnaires will be used to define the User Group format.

Finally, the option of linking the IRIS workstation to NAFIS is being actively explored by several forces operating the system. The practicality of achieving the NAFIS link via the force LAN and CJX has been demonstrated during a loan period of an IRIS workstation at West Mercia Police, and

the information related to this trial will be provided to current and prospective users to facilitate permanent connections.

New VMD machine goes operational

The pioneering VMD machine at PSDB was finally retired in March 2004, following nearly 30 years of use in optimisation of the VMD process. The machine had been used to develop the manufacturing specification for all machines now in use and although the essential features on modern machines are the same, the control technology has advanced considerably. This does not represent an end to VMD research at PSDB, as the technique is still regarded as one of the most sensitive techniques available for a wide range of surfaces. To ensure that future research is carried out on equipment more representative of that in operational use, a new machine has been installed and recently became operational.

The new VMD machine installed at PSDB

Less than two weeks after installation, the machine was successfully used for operational work using both the conventional gold/zinc deposition process, and the experimental silver deposition process outlined in the April 2004 Newsletter. Although the main purpose of the machine is to enable further research and development to be carried out by PSDB, it is intended that the equipment will be available for training of VMD operators and for operational work.

To date, the old VMD machine has not been scrapped and could be available to any force seeking to invest in VMD equipment. Although PSDB will not charge for the equipment, it does require overhaul and upgrading of the control systems to meet modern legislation, and this will be costly. However, the final cost of the upgraded system will be less than that of a new machine, and this may make the cost acceptable. If any force wishes to investigate this further, please contact us.

European Network of Forensic Science Institutes (ENFSI)

ENFSI was established in 1995 with the vision of ensuring that the quality of development and delivery of forensic science throughout Europe is at the forefront of the world. There are currently fifteen expert working groups within ENFSI covering a range of forensic disciplines. In 2001 a working group was established in the field of fingerprints (European Fingerprint Working Group (EFP-WG)).

The EFP-WG meets annually. The last meeting was held during September in Tallinn, Estonia and was represented by 45 member institutes from 27 countries across Europe. PSDB and the Forensic Science Service (FSS) represent the UK – unfortunately there is currently no representation from UK police forces. The ultimate aim for the EFP-WG is to produce a European best practice manual that covers the whole of the fingerprint process.

As the PSDB Manual of Fingerprint Development Techniques (MoFDT) is slowly becoming the standard around the world, the EFP-WG is considering using it as part of the European best practice manual.

Publications

Home Office Publication 54/04

The Powders Process, Study 1: Evaluation of Fingerprint Brushes for Use with Aluminium Powder

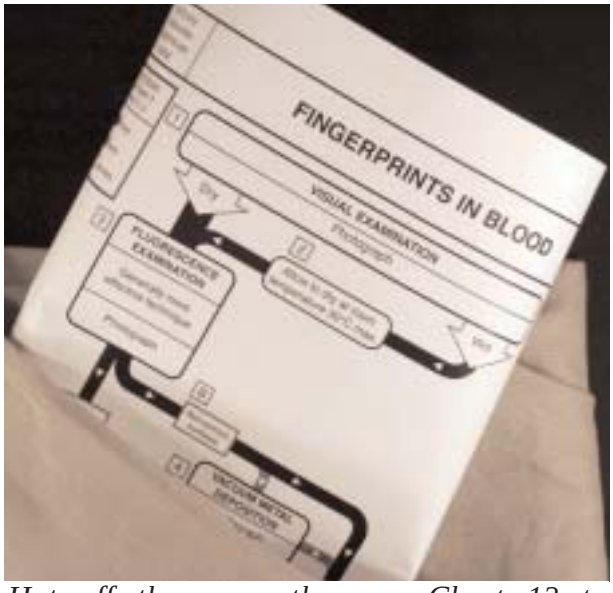
Helen Bandey

In our eagerness to circulate the information, the following corrections need to be pointed out:
Page footer should read 'PSDB Fingerprint Development and Imaging Newsletter August 2004' throughout.
Page 3, paragraph 1 should read '...1µm up to approximately 12 µm'.

Manual Update in preparation

Can you please ensure that your Manual of Fingerprint Development Techniques is registered. Modifications are being made to Chapter 2, Ninhydrin and DFO techniques as well as a new chart 12, new acid black 1 formulation, two new blood enhancement reagents and updated supplier information in Appendix II.

Please contact Corinne Gower on 01727 816454 to ensure that you receive the update as soon as it is available.



Hot off the press: the new Chart 12 to accompany the Manual of Fingerprint Development Techniques update.

The fingerprint team 'out of the office'

As employees of the Home Office, we are required to participate in an 'Out Of Office Experience' annually to widen our knowledge of the Home Office or participate in voluntary work. This year members of the team undertook some gardening duties at a local hospice. While we wish to encourage contact to assist forces in a number of disciplines, gardening will not be added to the list!

Members of the team with colleagues helping out with a little gardening

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October 2004

Fingerprint Development Handbook Order Form

PSDB is pleased to announce the first revision to the Fingerprint Development Handbook, due for publication early in 2005.

This will include information already published in the 2001 and 2004 updates of the Manual of Fingerprint Development Techniques and additional information on the use of superglue and dyeing at scenes of crime, yet to be included in the Manual.

PSDB will supply free of charge sufficient copies of the Handbook to issue to your Scenes of Crime Officers, Fingerprint Bureau and Fingerprint Development laboratories. We reserve the right to charge £10 per copy for any additional handbooks ordered.

To place your orders for copies of the new Handbook, please complete the form below and return by post or fax by December 31 2004:

ONLY ONE SUBMISSION PER FORCE PLEASE

Please enter the following details in the spaces provided and either post or fax back to Corinne Gower, Police Scientific Development Branch, Sandridge, St Albans, Herts AL4 9HQ
Tel: 01727 816454, Fax: 01727 816253

Name.....Police Force.....

Address.....

No of copies required for SOCOs.....No of copies required for Bureau.....

No of copies required for Laboratory.....No of additional copies required.....

Signed.....

Thank you for your cooperation

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