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Forensic Textile Fiber Examination Across the USA and Europe

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ABSTRACT: Crime laboratories in the USA, who undertake fiber examinations, together with members of the European Fibres Group (plus representatives from Israel, Japan, Canada, and Australia) were surveyed in 1994 and 1995, respectively, and asked to provide subject-specific information relating to personnel, equipment, training, quality control, and techniques available. The information obtained showed that generally more fiber casework is carried out in Europe than in the USA. Most laboratories are quite well equipped but those in Europe seem to be able to obtain more state-of-the-art instrumentation. Proficiency testing and peer review is accepted practice worldwide. Americans appear to update fiber collections on a more regular basis than Europeans but both keep literature up to date. Contamination is a major issue, as with all areas of trace evidence. The results from the survey suggest that minimum standards are clearly not always being observed. Careful consideration also needs to be given as to whether legitimate contact could have occurred prior to an offense being committed.

The standard of forensic fiber examination worldwide is generally high. With laboratory management continuing to support the work of the Scientific Working Group for Materials and the European Fibres Group and by instigating "best practice" as set out in their guidelines, standards should continue to improve.

KEYWORDS: forensic science, fiber, surveys, laboratories, SWGMAT, EFG, equipment, methodology

The Technical Working Group for Fiber Examination (TWGFIBE) was founded in February 1994 (1) for the purpose of advancement of fiber examination. It is primarily a North American group but invites representatives from Europe, Japan, and Australia to attend its meetings. In November 1995 it was decided to expand the expertise of the group to include hair, paint, and glass examination. Subsequently the group was renamed the Technical Working Group for Materials Analysis (TWGMAT).

In January 1999 it was announced that the name of all Federal Bureau of Investigation-led, forensic community working groups should substitute the word "scientific" for the word "technical" in their titles; thus, TWGMAT became SWGMAT. The reason grows from a need to delineate the well-established groups in the forensic community in the USA that are focused on long-term technical and performance guidelines and standards for various disciplines from those issue-specific, short-term "technical working groups" sponsored by other agencies.

The European Fibres Group (EFG) was formed (2) in November 1993 and, in addition to European Fibre specialists, representatives from the USA, Canada, Australia, and Israel attend its meetings. The group has members in 23 European countries and its aims are:

- to meet regularly and informally with the minimum of bureaucracy
- to exchange information
- to standardize techniques
- to carry out collaborative research

At the inaugural meeting of TWGFIBE it was decided to survey the USA crime laboratories (undertaking textile fiber examinations) to ascertain the personnel, equipment, training, and techniques available in these laboratories, also how and when fiber examinations are performed. Eventually members of the EFG were asked to complete the same questionnaire as the USA laboratories.

The information gained from the survey provides a relatively up-to-date profile of textile fiber examination being practiced around the world.

Method

The aim was to survey a large proportion of the USA and European laboratories that undertake textile fiber examination. A listing of the USA laboratories was obtained from the American Society of Crime Laboratory Directors (ASCLD) list. The European laboratories who took part were all members of the EFG.

A questionnaire was compiled and mailed to 214 American laboratories, 37 from Europe, 2 from Canada, and one each from Japan, Israel, and Australia, for a total of 256 laboratories. For collation purposes the Canadian and Japanese surveys were included with those from America and the Israeli and Australian with the Europeans.

The response rate for America was 47% and 82% for Europe, an overall response of 53%.

The Questionnaire

The questionnaire was divided into six categories: general laboratory information, prerequisite criteria for fiber cases, fiber recovery, analytical tests performed, quality control, and training. Participants were asked to complete all sections of the questionnaire, but inevitably some parts were incomplete when returned.

General Laboratory Information

The Type of Laboratory

As Table 1 shows, the vast majority of the laboratories are state or county, 70% fall into one of these two categories.

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TABLE 1—*Type of laboratory.*

Type	USA $n = 103$	Europe $n = 32$	Total $n = 135$
City	11 (11%)	1 (3%)	12 (9%)
County	17 (17%)	3 (9%)	20 (15%)
State	60 (58%)	14 (44%)	74 (55%)
Federal	4 (4%)	4 (13%)	8 (6%)
Regional	6 (6%)	4 (13%)	10 (7%)
Independent	2 (2%)	4 (13%)	6 (4%)
International	3 (3%)	2 (6%)	5 (4%)

NOTE: n = number

TABLE 2—*Total number of employees.*

Number	USA $n = 103$	Europe $n = 32$	Total $n = 135$
<10	21 (20%)	7 (22%)	28 (21%)
10–25	33 (32%)	4 (13%)	37 (27%)
26–50	27 (26%)	5 (16%)	32 (24%)
51–100	15 (15%)	9 (28%)	24 (18%)
>101	7 (7%)	7 (22%)	14 (10%)

The Total Number of Employees

Table 2 shows that the split between the larger and the smaller laboratories both within the USA and across Europe is reasonably consistent. However, in general, there are more small laboratories in the USA than in Europe.

Fiber Analysts

Of the USA laboratories, 85% have between 1 and 3 fiber analysts whereas in Europe the figure having this number is 53%. The USA has an average of 2.6 analysts per laboratory compared to 5.3 in Europe.

Of the analysts in the USA, 75% spend 30% or less of their time on fiber analysis, whereas in Europe the number of analysts spending such a small amount of their time is 14%. This is reflected in the average number of cases worked per year, which are 27 per analyst in the USA against 76 per analyst in Europe.

The range of experience for both American and European analysts is between 1 and 33 years, with an average of 10 years per analyst.

Laboratory Instrumentation

Each of the laboratories that took part in the survey was asked to mark which of the instruments that are listed in Table 3 are available to them in their working environment.

It appears that generally laboratories are well equipped. Although the actual number of visible and UV microspectrophotometers available in the USA is roughly equivalent to those in Europe, the percentage of laboratories that have access to this equipment is lower than in Europe.

PreRequisite Criteria for Fiber Cases

Each of the laboratories was asked to tick which of the case criteria in Table 4 they consider for determining whether fiber examinations are appropriate.

If the first statement did not contain the word "all" it seems likely that the figures obtained would be similar to those in the third statement. Obviously the results associated with statement two are of interest. If the analyst is aware of contact just before the offence, then fiber transfer, as a means of demonstrating positive association, should not be attempted. The only possible exception is if the request is to look for fibers under fingernails.

The second question in this section was to list fabrics or fiber types not routinely examined. The results appear in Table 5.

TABLE 3—*Laboratory instrumentation.*

Instrument	USA $n = 103$	Europe $n = 32$	Total $n = 135$
Polarized light microscope	101 (98%)	32 (100%)	133 (99%)
Comparison microscope	101 (98%)	26 (81%)	127 (94%)
Fluorescence microscope	39 (38%)	27 (84%)	66 (49%)
Hot stage microscope	79 (77%)	24 (75%)	103 (76%)
Microspectrophotometer-ultraviolet	12 (12%)	17 (53%)	29 (22%)
Microspectrophotometer-visible	39 (38%)	25 (78%)	64 (47%)
Microspectrophotometer-fluorescence	12 (12%)	13 (41%)	25 (19%)
Infrared spectrophotometer (dispersive)	20 (19%)	9 (28%)	29 (22%)
Fourier transform infrared spectrometer	22 (21%)	31 (97%)	53 (39%)
FTIR with microscope	78 (76%)	26 (81%)	104 (77%)
Gas chromatograph/pyrolysis	73 (71%)	21 (66%)	94 (70%)
Gas chromatograph/mass spectrometer	87 (85%)	21 (66%)	94 (70%)
Scanning electron microscope/EDX	49 (48%)	26 (81%)	75 (56%)
High-performance liquid chromatography	37 (36%)	21 (66%)	58 (43%)

TABLE 4—*Prerequisite criteria for fiber cases.*

Criteria	USA $n = 103$	Europe $n = 32$	Total $n = 135$
All contact cases between two or more individuals	35 (34%)	19 (59%)	54 (40%)
Only contact cases where no previous contact has occurred (as far as can be established)	46 (45%)	16 (50%)	60 (44%)
Contact between objects or an individual and an object	69 (67%)	28 (88%)	97 (72%)
Dependent on type of fabric or fibers involved	37 (36%)	11 (34%)	48 (36%)
Other/each case evaluated independently	10 (10%)	0 (0%)	10 (7%)

TABLE 5—*Fabrics and fiber types not routinely examined.*

Fabric/Fiber Type	USA $n = 79$	Europe $n = 24$	Total $n = 103$
Undyed cotton	36 (46%)	13 (54%)	49 (48%)
Blue denim	15 (19%)	11 (46%)	26 (25%)
Undyed polyester	7 (9%)	0 (0%)	7 (7%)
Blue cotton	5 (6%)	0 (0%)	5 (5%)

TABLE 6—*Would any particular criteria preclude fiber analysis?*

Evidence Type	USA $n = 89$	Europe $n = 13$	Total $n = 112$
No criteria	38 (43%)	0 (0%)	38 (34%)
Case dependent	15 (17%)	0 (0%)	15 (13%)
Fingerprints	13 (15%)	5 (38%)	18 (16%)
DNA	12 (13%)	8 (62%)	20 (18%)

TABLE 7—*Techniques used for fiber recovery.*

Technique	USA $n = 102$	Europe $n = 32$	Total $n = 134$
Manual recovery with tweezers	90 (88%)	26 (81%)	116 (87%)
Tape lifting	76 (75%)	32 (100%)	108 (81%)
Scraping	69 (68%)	5 (16%)	74 (55%)
Vacuuming	47 (46%)	8 (25%)	55 (41%)
Other	7 (7%)	3 (9%)	10 (7%)

Laboratories where staff wear white cotton/polyester laboratory coats should not search for or examine these fibers in a casework context. The same rules would apply if another laboratory issued their staff with blue or any other colored laboratory coats. Denim material is usually colored with a simple indigo dye and is very common in both the USA and European clothing populations; therefore, its evidential value is generally limited.

The final question in this section asked if criteria such as positive associations from other evidence would preclude the analysis of fibers in casework. The answers appear in Table 6.

As expected, the most common reasons for not carrying out fiber examinations was where evidence had already been obtained from fingerprints or DNA. Quite clearly, from the replies received, there is a trend in this direction in Europe. It is the author's view that every case is individual and should be judged accordingly. However, issues such as cost, timing (court dates), and the amount of forensic work required by the customer may all contribute to whether or not a fiber examination is carried out. These issues are particularly important when DNA and/or fingerprint evidence is readily available.

Fiber Recovery

The first question in this section asked which technique(s) does the laboratories use for recovery of fiber evidence. Table 7 shows that the available techniques are limited but all are used.

Clearly most laboratories use more than one technique to recover fibers. The four techniques above are practiced by many of the American laboratories; however, in Europe, the techniques used generally are taping and, where appropriate, manual recovery.

Tape lifts, both in the USA and Europe, are stored in many ways, but generally the backing is clear and can be plastic, glass, acetate, polyester, etc.

When asked "Do you routinely tape lift even if fiber examinations have not been requested but transfer is a possibility?" the answers given by American and European laboratories appeared to be very different. In the USA only 34% replied with a clear or qualified yes. In Europe it was 57%.

Although Table 7 shows that tape lifts are the most popular collection technique, only 42% of the American laboratories use them predominantly (as "first choice"), whereas in Europe it is 82%. Scraping is reasonably popular in the USA with 26% of the laboratories using it predominately, but vacuuming is first choice for only 3% of laboratories. In Europe neither technique is popular with only one and two laboratories, respectively, opting for scraping and vacuuming as first choice.

The next question concerned procedures followed to avoid contamination when examining items of evidence from questioned and known sources. Answers appear in Table 8.

While it is generally the responsibility of the police, crime scene examiner, or identification officer to maintain the integrity of exhibits prior to their arrival at the laboratory, once they are there it is the scientist who takes over this responsibility. Proper and adequate precautions must be in place to avoid contamination of the exhibits. Minimum requirements (3,4, EFG-Manual of Best Practice for Forensic Fibre Examination personal communication) are to have clean work surfaces and to change laboratory coats in between examining items from victims and suspects or suspects and scenes of crime. It is preferable to examine exhibits in different rooms, but this can be difficult where space is limited. This may not be related to the overall size of the laboratory. The only option is to ensure as much physical separation as space permits and/or a reasonable time period passes before exhibits are examined in the same area and that adequate cleaning has been carried out. It is clear from the survey that some laboratories do not observe these minimum requirements.

The use of lasers or alternative light sources, as an aid, when recovering fibers is far more prevalent in the USA with 85 (83%) against 11 (34%) from Europe.

The last part of this section dealt with the types of mounting media that are used. The most popular, in decreasing order, in the USA are Permount, cargille liquid, Norland optical adhesive, xylene, Meltmount, Aroclor, and Pro-texx. In Europe it was glycerine/glycerol, phytohistol, XAM, water, xylene, and Canada balsam that headed the list. Many laboratories used more than one mounting media.

Analytical Tests Performed

A list of fiber characteristics, properties examined, and techniques available for forensic fiber comparison and examination was issued to each laboratory. They were asked to note which of the above were routinely or occasionally used. The results appear in Tables 9 and 10.

Microscopy

Microscopy is obviously one of the main tools of the forensic fiber examiner, and the vast majority of the laboratories worldwide have both brightfield and polarizing microscopes. A high proportion also has comparison microscopes, which are considered by

TABLE 8—*Procedures followed to avoid contamination.*

Precaution	USA $n = 102$	Europe $n = 32$	Total $n = 134$
Change lab. coats	46 (45%)	24 (75%)	70 (52%)
Clean work surface	97 (95%)	27 (84%)	124 (93%)
Use separate exam. rooms	42 (42%)	22 (69%)	64 (48%)
Wait time period	11 (11%)	6 (19%)	17 (13%)

TABLE 9—*Fiber characteristics, properties examined, and techniques used for comparison and examination—routinely.*

Test	USA $n = 103$	Europe $n = 32$	Total $n = 135$
Microscopy (brightfield)	100 (97%)	32 (100%)	132 (98%)
Color	101 (98%)	32 (100%)	133 (99%)
Crimp/texturizing	74 (72%)	19 (59%)	93 (69%)
Damage/debris	71 (69%)	18 (56%)	89 (66%)
Diameter	94 (91%)	29 (91%)	123 (91%)
Cross-section	66 (64%)	17 (53%)	83 (62%)
Modification ratio	8 (8%)	2 (6%)	10 (7%)
Delusterant/inclusions	86 (84%)	28 (88%)	114 (84%)
Polarized light microscopy	97 (94%)	28 (88%)	125 (93%)
N parallel	73 (71%)	2 (6%)	75 (56%)
N perpendicular	72 (70%)	5 (16%)	77 (57%)
Sign of elongation	80 (78%)	13 (41%)	93 (69%)
Birefringence	84 (82%)	12 (38%)	96 (71%)
Pleochroism	60 (58%)	7 (22%)	67 (50%)
Dispersion staining	12 (12%)	4 (13%)	16 (12%)
Fluorescence microscopy	24 (23%)	24 (75%)	48 (36%)
Comparison microscopy	91 (88%)	22 (69%)	113 (84%)
Melting point	16 (16%)	4 (13%)	20 (15%)
Solubility	39 (38%)	8 (25%)	47 (35%)
Microspectrophotometry UV	3 (3%)	14 (44%)	17 (13%)
Microspectrophotometry visible	35 (34%)	24 (75%)	59 (44%)
Microspectrophotometry microfluorimetry	4 (4%)	0 (0%)	4 (3%)
Dye extraction	6 (6%)	10 (31%)	16 (12%)
TLC of dyes	8 (8%)	12 (38%)	20 (15%)
HPLC of dyes	0 (0%)	0 (0%)	0 (0%)
IR spectroscopy	2 (2%)	1 (3%)	3 (2%)
FTIR spectroscopy	22 (21%)	8 (25%)	30 (22%)
FTIR microspectroscopy	50 (49%)	20 (63%)	70 (52%)
GC pyrolysis	9 (9%)	1 (3%)	10 (7%)
SEM-EDX	2 (2%)	3 (9%)	5 (4%)
Other	2 (2%)	1 (3%)	3 (2%)

many to be a necessity for fibers work. It is interesting to note that Europe generally uses fluorescence microscopy far more than the USA. Indeed, 75% of Europe use it as opposed to only 23% in the USA. The morphological and optical features taken into account when using microscopy are essentially similar throughout all laboratories.

Spectrophotometry/Chromatography/Spectroscopy

When color is being examined and compared beyond the initial microscopy stage it is the European laboratories that are better equipped. Only 3% of the USA laboratories have a UV microspectrophotometer against 44% of the European, and more importantly 75% of the Europeans have a visible microspectrophotometer as opposed to 34% in the USA. Generally, in Europe, laboratories that do not have a microspectrophotometer tend to use TLC to examine the dye. There are still 38% of the European laboratories using this technique routinely but only 8% in the USA. However on an occasional basis the American laboratories are bigger users of TLC with 45% as against 31% in Europe. The usage of FTIR microspectroscopy is slightly higher in Europe with 63% of the laboratories using the technique compared to 49% in the USA.

Cross-Sectioning Techniques

A wide range of techniques is used in both Europe and the USA. In summary, it is sufficient to say that the fiber to be sectioned is embedded in a mounting media, melted olefin or between acetate sheets, and sectioned by hand, using a razor blade or by microtome.

Analysis of Bicomponent/Biconstituent Fibers

Those laboratories that have encountered such fibers use a range of microscopical techniques including brightfield, polarized light, interference, and phase contrast. These are generally supported by FTIR, solubility testing, and cross-sectioning.

Measurement/Estimation of Refractive Index and Birefringence

The survey shows that over 65% of laboratories from both continents estimate the values using a compensator.

Analysis of Undyed Polyester and Cotton

There were 90 replies from the USA and 28 from Europe relating to polyester analysis; 10% of the USA laboratories and 18% of the Europeans would not analyze undyed polyester. Those that would chose microscopy and FTIR as the popular techniques for analysis.

In relation to undyed cotton, 100 replies were received from the USA and 18 from Europe. Undyed cotton would not be examined by 41% of the USA laboratories and 56% of the Europeans. Microscopy was the preferred form of analysis.

TABLE 10—*Fiber characteristics, properties examined, and techniques used for comparison and examination—occasionally.*

Test	USA $n = 103$	Europe $n = 32$	Total $n = 135$
Microscopy (brightfield)	0 (0%)	0 (0%)	0 (0%)
Color	0 (0%)	0 (0%)	0 (0%)
Crimp/texturizing	9 (9%)	6 (19%)	15 (11%)
Damage/debris	12 (12%)	5 (16%)	17 (13%)
Diameter	3 (3%)	3 (9%)	6 (4%)
Cross-section	29 (28%)	10 (31%)	39 (29%)
Modification ratio	25 (24%)	5 (16%)	30 (22%)
Delusterant/inclusions	2 (2%)	1 (3%)	3 (2%)
Polarized light microscopy	3 (3%)	1 (3%)	4 (3%)
N parallel	15 (15%)	6 (19%)	21 (16%)
N perpendicular	15 (15%)	6 (19%)	21 (16%)
Sign of elongation	8 (8%)	2 (6%)	10 (7%)
Birefringence	9 (9%)	9 (28%)	18 (13%)
Pleochroism	8 (8%)	1 (3%)	9 (7%)
Dispersion staining	12 (12%)	1 (3%)	13 (10%)
Fluorescence microscopy	11 (11%)	3 (9%)	14 (10%)
Comparison microscopy	5 (5%)	1 (3%)	6 (4%)
Melting point	50 (49%)	19 (59%)	69 (51%)
Solubility	39 (38%)	15 (47%)	54 (40%)
Microspectrophotometry UV	3 (3%)	3 (9%)	6 (4%)
Microspectrophotometry visible	5 (5%)	1 (3%)	6 (4%)
Microspectrophotometry microfluorimetry	4 (4%)	5 (16%)	9 (7%)
Dye extraction	43 (42%)	11 (34%)	54 (40%)
TLC of dyes	46 (45%)	10 (31%)	56 (42%)
HPLC of dyes	7 (7%)	2 (6%)	9 (7%)
IR spectroscopy	6 (6%)	4 (13%)	10 (7%)
FTIR spectroscopy	14 (14%)	5 (16%)	19 (14%)
FTIR microspectrophotometry	18 (18%)	7 (22%)	25 (19%)
GC pyrolysis	22 (21%)	5 (16%)	27 (20%)
SEM-EDX	24 (23%)	15 (47%)	39 (29%)
Other	4 (4%)	1 (3%)	5 (4%)

The next question in this section asked whether the scientist would report the presence of one matching fiber. Of the 28 European laboratories that replied, 72% said yes they would, whereas in the USA 95% of the 98 who replied gave either a yes or qualified yes. This gave a 90% yes or qualified yes reply over all.

When scientists were asked about reporting positive associations of dyed fibers from denim fabrics, 29 of the Europeans replied and 52% gave a yes or qualified yes. In the USA 57% of the 96 replies were also positive, giving an overall positive percentage of 56%.

When asked "What techniques are used in the analysis of dyed cotton?" a wide range of answers were received. Table 11 shows the range of techniques and how often they are used, whereas Table 12 shows which are used either singularly or in combination by the different laboratories.

Tables 11 and 12 clearly show that microscopy, microspectrophotometry, and TLC (either used on their own or in combination) are the chosen techniques, worldwide, for the analysis of dyed cotton.

Quality Control

When asked if their laboratories participated in external proficiency testing, the response from both the USA and Europe was positive. In fact 98% of the American laboratories and 94% of the Europeans did take part. However, when asked about internal proficiency testing, the outcome, although similar worldwide, was very different. The numbers completing this part of the survey were 103 Americans and 31 Europeans, almost identical to those that completed the first part in this section. This time only 33% of the Americans and 42% of the Europeans came up with a positive reply.

Peer reviewing of casework was also greeted with an overwhelming yes vote. Three out of four of both the Americans (102 replies) and the Europeans (30 replies) said that peer reviewing took place. When asked about the format of such reviews, the replies varied. As Table 13 shows, six alternatives were offered and some laboratories ticked more than one option. Clearly in the USA data review is the first choice followed by the final report and then a review of evidence and data. In Europe it is the final report followed by evidence and data review and a re-examination of positive associations that are considered to be the priorities.

Fiber reference collections formed the basis for the last two questions in this section. Scientists were asked if their laboratories maintained a collection and if it was regularly updated. The number of laboratories worldwide, which had collections, was high, although the standard is unknown, 94% in the USA and 74% in Europe. However, when it came to updating, the Americans were quite good, 64%, but the Europeans need to improve dramatically, 19%.

Training

The survey shows that fewer than half the laboratories surveyed worldwide have a written training program. The programs that are in place are very variable and last from a minimum of 20 h to four years to complete. Funding for external classes/seminars appears to be more readily available in the USA than in Europe, with 77 and 57% of the laboratories, respectively, obtaining adequate funding, although worldwide 60% of the replies said than only one or less external classes were available per scientist per year. Access to forensic or textile related literature was very good worldwide with positive replies in excess of 80%. Although 72% of American replies said that their literature reference sources were continually updated, the Europeans improved on this figure with 94% of their replies being positive.

TABLE 11—*Techniques used in the analysis of dyed cotton.*

Technique/Test	USA $n = 89$	Europe $n = 32$	Total $n = 121$
Microscopy	72 (81%)	22 (69%)	94 (78%)
Microspectrophotometry	34 (38%)	23 (72%)	57 (47%)
TLC/Dye Classification	34 (38%)	17 (53%)	51 (42%)
HPLC	2 (2%)	1 (3%)	3 (2%)
CZE	0 (0%)	1 (3%)	1 (1%)
FTIR	4 (4%)	0 (0%)	4 (3%)
PGC	1 (1%)	0 (0%)	1 (1%)
Solubility	1 (1%)	0 (0%)	1 (1%)

TABLE 12—*Combinations of techniques used in the examination of dyed cotton.*

Techniques/Tests	USA $n = 89$	Europe $n = 32$	Total $n = 121$
Microscopy	29 (33%)	4 (13%)	33 (27%)
Microscopy + microspec	17 (19%)	7 (22%)	24 (20%)
Microscopy + TLC	12 (13%)	3 (9%)	15 (12%)
Microscopy + microspec + TLC	9 (10%)	11 (33%)	20 (17%)
Microspectrophotometry	6 (7%)	4 (13%)	10 (8%)
HPLC	0 (0%)	1 (3%)	1 (1%)
TLC + CZE	0 (0%)	1 (3%)	1 (1%)
TLC	9 (10%)	1 (3%)	10 (8%)
TLC + HPLC	1 (1%)	0 (0%)	1 (1%)
Microscopy + FTIR + TLC	1 (1%)	0 (0%)	1 (1%)
Mcroscopy + HPLC	1 (1%)	0 (0%)	1 (1%)
Microscopy + FTIR	2 (2%)	0 (0%)	2 (2%)
Microscopy + Solubility + PGC + FTIR + TLC	1 (1%)	0 (0%)	1 (1%)
Microspectrophotometry + TLC	1 (1%)	0 (0%)	1 (1%)

TABLE 13—*Peer review.*

	USA $n = 103$	Europe $n = 25$
Data review only	38 (37%)	4 (16%)
Re-examination of evidence	8 (8%)	7 (28%)
Data review of only positive associations	9 (9%)	7 (28%)
Re-examination of positive associations only	8 (8%)	9 (36%)
Review of evidence and data	28 (27%)	13 (52%)
Review of final report only	29 (28%)	15 (60%)

Conclusion

It appears that very few independent laboratories are undertaking fibers work. However, it should be borne in mind that many private laboratories are not members of ASCLD and therefore are unlikely to have been involved in this survey. Nearly 70% of the European countries have only one laboratory. Laboratories in Europe, as a consequence, tend to be larger than in the USA. The Europeans have twice as many analysts per laboratory as compared with the USA. Obviously, with fewer laboratories, more analysts are focused in one area in Europe. Generally more fiber work is carried out in Europe than in the USA. In the author's experience it

seems likely that with so many USA cases being crimes against the person, very little, if any, time is available to deal with less serious cases where fiber contact may have occurred. In Europe fiber evidence is often used in cases of robbery and terrorism as well as to support DNA evidence in cases where body fluids are present (as in the USA) but is additionally used in less serious crime, i.e., taking cars without the owners' consent. One may wish to speculate that with many more firearms being available in the USA that blood is shed more regularly than in Europe and hence blood grouping and DNA may be more of a priority. Most laboratories are reasonably well equipped for fiber work but with far less laboratories per country in Europe, most of which are government run, it may be easier for them to obtain more modern equipment. Microspectrophotometers are now almost standard in Europe, whereas in the USA only just over one third of the laboratories have one.

Where recent legitimate contact, between two or more individuals, is known to have occurred prior to or after a crime, or when items are known to have been contaminated, then it is vitally important to realize, that in the majority of cases, there is no point in examining clothing or other items for fiber transfer. The wording in the questionnaire may have been ambiguous, leading to overstated survey figures. These figures suggest that fiber examinations are conducted in instances where the background information should lead the examiner to decline from examining certain or all exhibits in specific cases. Laboratory managers may wish to review their laboratories procedures regarding this matter, in line with accepted guidelines (3,4, EFG—*Manual of Best Practice for Forensic Fibre Examination,* personal communication)

The survey supports the author's view that undyed cotton and blue denim are two of the most common fiber types that are not routinely searched for or examined in many laboratories worldwide. However, still over 50% of the laboratories surveyed inferred that they do search for them. One hopes that the level of significance generally placed on fibers such as these, which are prevalent in society, is low (3,4, EFG—*Manual of Best Practice for Forensic Fibre Examination,* personal communication).

Tape lifting and manual recovery are clearly the techniques of choice for recovery of fibers. With many laboratories beginning to show interest in fiber finding instrumentation, one would expect even more laboratories in the USA to consider moving toward tape lifting as the main technique for fiber retrieval. Although tape lifting is used only as the predominant technique in 42% of US laboratories as opposed to 82% in Europe, 75% of US laboratories and all European laboratories use it at some time. In the USA, scraping and vacuuming are used to support tape lifting and manual recovery as the techniques of choice. In Europe scraping and vacuuming are used only rarely.

The survey indicates that greater precautions are taken to avoid contamination in Europe than in the USA. Less than half of those that replied from the USA said that staff change laboratory coats in between examinations where avoidance of contamination is necessary even though this is recommended by the Working Groups. Although 75% of Europeans said that they do change coats, there are still 25% who don't. Management should ensure that all staff worldwide follow the recommended guidelines (3,4, EFG—*Manual of Best Practice for Forensic Fibre Examination,* personal communication). If these guidelines are not adhered to, fiber examination should no longer be carried out in that laboratory.

It is quite clear that proficiency testing is important, and it is encouraging that approximately 95% of laboratories worldwide take part in external testing programs. Peer reviewing is also thought to be important. Many fiber collections exist, but whether the collections are authenticated was not covered in this survey. Access to relevant literature is good throughout the world, but training generally needs to be improved with at the very least a written program being available.

Forensic fiber examination worldwide is generally of a high standard. However, issues have come to light from the survey that must be addressed, particularly by individual laboratories, with great urgency. It is the responsibility of management within their own laboratories to ensure that staff are working to standards that ensure that all aspects of fiber searching, examination, and analysis are performed satisfactorily.

SWGMAT has already produced a document entitled "Forensic Fiber Examination Guidelines" (available at www.fbi.gov) and the EFG is currently working on their *Manual of Best Practice.* It is documents such as these that will assist managers in judging if the daily practices carried out in their laboratories are acceptable. The chairmen and other experienced members of both groups are always willing to advise on and discuss any matters that management considers necessary. We are all striving to improve standards and practices of fiber work, and it is surveys such as this that help us to benchmark a laboratory's procedures, methodology, and instrumentation against others.

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