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The Status of Forensic Science Degree Programs in the United States

Forensic science faces no problem more pressing than the education and training of the scientists who staff the nation's forensic science laboratories. If one examines the critical research needs of the profession, the shortage of truly qualified laboratory scientists and supervisors, or the crisis of overwhelming case loads and backlogs, one finds that the most essential element in satisfying these needs is a core of scientifically qualified personnel. Again, when the need for maintaining high quality control (assurance) standards or for developing high ethical awareness among the professionals is under discussion, we inevitably find that laboratory personnel and the quality of their educational backgrounds are the main focus.

These observations apply to the entire forensic science field, which is composed of many disciplines including, but not limited to, criminalistics, pathology, toxicology, odontology, and document examination. Criminalistics, which itself is quite broad, is generally considered to be the scientific analysis and examination of physical evidence, its interpretation, and its presentation in court. While criminalistics is only one of the many disciplines which make up the forensic sciences, several university level programs, although focusing on criminalistics, employ the generic term forensic science to describe their curricula. This study examines forensic science degree programs which clearly emphasize the concepts and methods normally associated with criminalistics. On occasion, the terms "criminalistics" and "forensic science" will be used interchangeably.

The criminalistics profession has grown dramatically within the last decade. Since the President's Crime Commission of 1967 and the birth of the Law Enforcement Assistance Administration in 1968, we have witnessed a rapid upswing of science and technology in the criminal justice process. The criminalistics laboratory has developed as the principal scientific component of the criminal justice system, performing scientific and objective evaluations of physical evidence. However, most of the personnel within these laboratories do not have specialized degrees in forensic science but have entered the forensic science field with degrees in the natural sciences, having acquired expertise through years of practical experience.

There has been a dearth of published information on educational programs in forensic science, both domestically and internationally. The recent Forensic Science Foundation's "Assessment Project" sought to identify institutions and agencies offering educational courses or programs in the forensic sciences and to evaluate the availability of these programs [1]. Soon to be published, this study served to identify programs covering the total spectrum of the forensic sciences but, given the scope of the project, did not offer detailed descriptive information about individual programs.

Presented at the 28th Annual Meeting of the American Academy of Forensic Sciences, Washington, D.C., 20 Feb. 1976. Received for publication 8 March 1976; revised manuscript received 7 May 1976; accepted for publication 19 May 1976.

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Method

In preparation for this year's American Academy of Forensic Sciences panel discussion on "Organizing and Developing Curricula in Forensic Sciences," a study was undertaken to gather basic information on all forensic science/criminalistics degree programs in the United States. The fundamental purpose was to gather sufficient information to enable educators, professionals, and law enforcement administrators to evaluate and discuss objectively the current status and probable future directions of education in the criminalistics profession.

We, therefore, determined that our initial objective would be to locate all bona fide institutions in the nation that grant forensic science degrees. It was noted that many of the more than 600 criminal justice programs around the nation offered course work in criminalistics, but our immediate objective was to gather as much information as possible about those colleges and universities which were offering degrees in forensic science or criminalistics. To reiterate, no attempt was made to identify programs outside the basic criminalistics field; programs in forensic toxicology, pathology, anthropology, and so forth were excluded. Once the programs were identified, efforts were made to gather basic descriptive information about each institution which offered a bachelors, masters, or doctoral degree.

An initial list of institutions was compiled based on our personal knowledge, information provided by associates in other programs, and through a review of the forensic science literature [2-9], including the Forensic Science Foundation's survey and the *Law Enforcement and Criminal Justice Education Directory* [10]. We realized that this list might have been incomplete, so it was sent to all listed institutions with the request that they supply the names of any other programs which were reported to offer degrees.

The response to this first inquiry provided us with the names and directors of the programs in the country. As our study continued, additional names and institutions were contacted and the master list was updated. All institutions were asked if they would answer a questionnaire providing essential information on the history, philosophy, facilities, faculty, students, and curricula of their own program. All institutions reported they would cooperate, and questionnaires were mailed to 22 colleges and universities. We were pleased to have 19 institutions respond, which constitutes an 86% response rate. Not all of the schools were able to answer all of the questions, so many of the following tables reflect data provided by fewer than 19 institutions. The n variable for each table indicates the number of responses tabulated for that particular question.

Presentation of Data

As illustrated in Table 1, there are 21 colleges or universities in the United States which offer degrees in criminalistics/forensic science. One additional institution, Georgetown University of Washington, D.C., does not offer a degree but does give a certificate in the examination of questioned documents. From this table it can be determined that nine schools offer only the Bachelor of Science degree, three offer the Master of Science, seven offer both the masters and the bachelors, one has the masters and doctorate, and one offers the bachelors, masters, and doctorate. The George Washington University offers two degrees: the Master of Science in Forensic Science and the Master of Forensic Sciences. The two should be distinguished as the latter does not require its candidates to have a scientific background prior to entry into the program. Some institutions reported they had plans of offering additional degrees in coming years, but for the purposes of the study, the degree programs recognized were those operating in the fall of 1975.

Table 1 also shows the year in which each of the institution's first forensic science degree program began. The two earliest programs on record are those at Michigan State

TABLE 1—*Forensic science degree programs.*

Institution	Year Program Established	Degrees Offered
Michigan State University	1947	B.S., M.S.
University of California (Berkeley)	1950	B.S., M.S., D.Crim.
California State University (L.A.)	1957	M.S.
Northern Arizona University	1959	B.S., M.S.
The George Washington University	1968	M.S., M.F.S.
John Jay College of Criminal Justice	1968	B.S., M.S.
University of Pittsburgh	1969	M.S.
State University College at Buffalo	1971	B.S.
Georgetown University	1972	Certificate
University of Illinois at Chicago Circle	1972	B.S., M.S.
University of New Haven	1972	B.S.
East Texas State University	1973	B.S., M.S.
California State University (Sacramento)	1973 ^a	B.S.
Indiana State University	1974	B.S.
Florida Technological University	1974	B.S.
Jacksonville State University	1974	B.S., M.S.
Metropolitan State College	1974	B.S.
University of Mississippi	1974	B.S.
Eastern Kentucky University	1975	B.S.
Northeastern University	1975	M.S., Ph.D.
Sam Houston State University	not available	B.S., M.S.
Southeast Missouri State University	not available	B.S.

^aB.A. in Criminal Justice with concentration in forensic science established in 1969.

University and the University of California at Berkeley, which were initiated in 1947 and 1950, respectively. It should be noted that an informal program existed at Berkeley as early as the mid-1930s.

Figure 1 is a graph that plots the cumulative number of institutions offering degrees in forensic science according to the year in which they were established. It can be seen that practically as many programs have developed since 1973 as in all the years prior to that date. At least nine new programs have formed within the past three years.

It is difficult to predict what the growth rate of new programs will be in the next five years (up to 1980), but it seems reasonable to assume that even more institutions will be offering programs.

Figure 2 is a map of the United States marked with the location of the various programs. In general geographic terms it is evident that the northeastern section of the United States has the largest number of programs (six), followed by the midwestern and the southern areas with five each. The northwestern section is the only area within the United States without a single program.

Institutions were asked to describe the position held by the forensic science program within the total university. The most common placement is within a department of chemistry or science. Almost an equal number of programs is located within criminal justice or law enforcement departments. Of these latter arrangements, most criminal justice departments maintain joint programs with departments of chemistry which provide necessary faculty, courses, and laboratories. The third principal type is within a division of liberal arts or social sciences, again with a liaison to a chemistry or science department. Table 2 illustrates the above placement information.

Table 3 is a tabulation of the different degree titles awarded in the programs. An equal number of forensic science and criminalistics titles are used to qualify the Bachelor of Science degree. Two of the undergraduate and three of the graduate degrees are in forensic chemistry, however.

Table 4 provides an approximation of the number of degrees in forensic science/crimi-

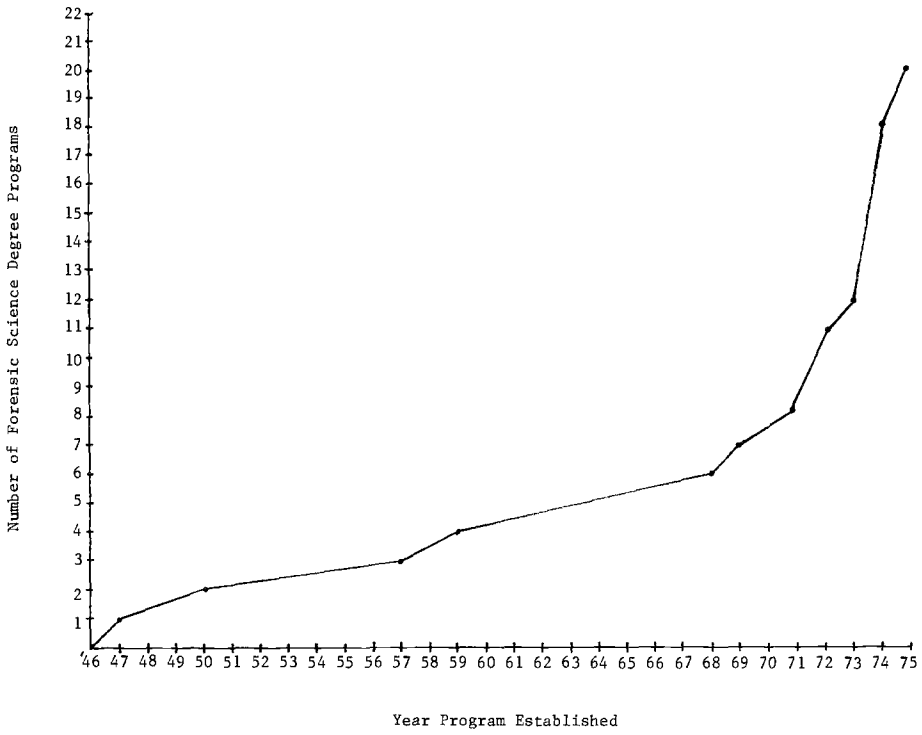


FIG. 1—Growth of forensic science degree programs in the United States during 1947 to 1975.

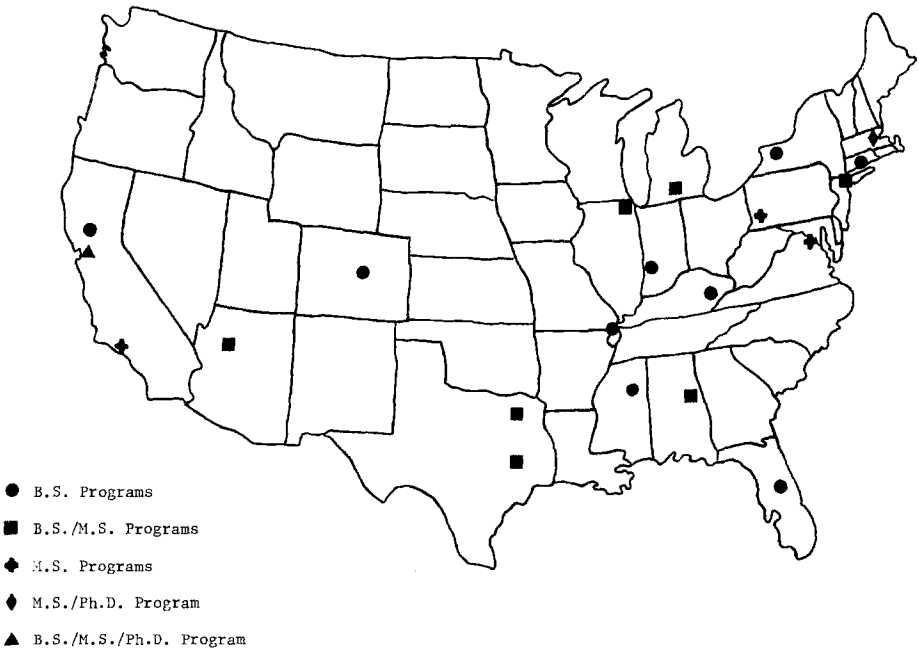


FIG. 2—Forensic science degree programs by geographical location.

TABLE 2—*University placement.*

Position Program Occupies in University	Undergraduate	Graduate	Total
Departments of Science/Chemistry	7	4	11
Criminal Justice/Law Enforcement/Criminology	5	4	9
Liberal Arts/Social Science	2	3	5

TABLE 3—*Forensic science degree titles.*

Degree Title	Undergraduate	Graduate	Total
Forensic Science	7	3	10
Criminalistics	5	5	10
Forensic Chemistry	2	3	5
Document Examination ^a	...	...	1

^aSpecial Certificate Program at Georgetown University.

TABLE 4—*Degrees conferred in 1974-1975.^a*

Institution	B.S.	M.S.	Doctorate
Michigan State University	0	0	NA
University of California (Berkeley)	6	1	0
California State University (L.A.)	NA	3	NA
Northern Arizona University	2	0	NA
The George Washington University	NA	40	NA
John Jay College of Criminal Justice	12	2	NA
University of Pittsburgh	NA	11	NA
Georgetown University	(7) ^b	NA	NA
University of Illinois at Chicago Circle	6	1	NA
University of New Haven	2	NA	NA
East Texas State University	1	0	0
California State University (Sacramento)	5	NA	NA
Indiana State University	0	NA	NA
Florida Technological University	0	NA	NA
Jacksonville State University	0	0	NA
Metropolitan State College	0	NA	NA
University of Mississippi	0	NA	NA
Eastern Kentucky University	0	NA	NA
Northeastern University	NA	0	0
State University College at Buffalo	1	NA	NA
Total	35	58	0

^aNA = not applicable.

^bSpecial Certificate Program at Georgetown University.

nalistics awarded in the 1974-1975 academic year. Thirty-five bachelors degrees, 58 masters degrees, and no doctorates were awarded. John Jay College of Criminal Justice awarded the greatest number of bachelors degrees (12), while The George Washington University granted the greatest number of masters degrees (40). The University of Pittsburgh awarded 11 masters degrees.

The institutions were also asked to provide the total number of degrees awarded since the inception of their programs. Table 5 provides the response to this question. Approxi-

TABLE 5—Total number of degrees awarded since program's inception.

Institution	B.S.	M.S.	Doctorate
Michigan State University	36	5	NA
University of California (Berkeley)	150	12	11
California State University (L.A.)	NA	25	NA
Northern Arizona University	15	0	NA
The George Washington University	NA	150	NA
John Jay College of Criminal Justice	40	7	NA
State University College at Buffalo	1	NA	NA
University of Pittsburgh	NA	49	NA
Georgetown University	(21) ^a	...	...
University of Illinois at Chicago Circle	16	1	NA
University of New Haven	5	NA	NA
East Texas State University	2	0	NA
California State University (Sacramento)	10	NA	NA
Indiana State University	0	NA	NA
Florida Technological University	0	NA	NA
Jacksonville State University	0	0	NA
Metropolitan State College	0	NA	NA
University of Mississippi	0	NA	NA
Eastern Kentucky University	0	NA	NA
Northeastern University	NA	0	0
Total	275	249	11

^aSpecial Certificate Program at Georgetown University.

mately 275 B.S. degrees have been awarded by all the institutions since 1947. The University of California at Berkeley has granted the most undergraduate degrees in criminalistics (150), while John Jay College has awarded 40. A total of 249 masters degrees have been granted, with The George Washington University providing the bulk of them with 150 (which includes both M.S. and M.F.S. degrees awarded). The University of Pittsburgh has awarded 49 masters degrees in forensic chemistry. In the doctoral category, the University of California at Berkeley has granted all 11 doctoral degrees.

There is difficulty estimating the number of degrees which will be granted in the next five to ten years, particularly since so many of the new programs have yet to produce their first graduate. In fact, six of the bachelors programs, four of the masters programs, and one of the doctoral programs have not awarded a degree as yet. Also, many of the established programs have experienced a noticeable increase in undergraduate and graduate enrollments in recent years.

Table 6 illustrates the responses of the institutions to a question asking how many students are currently enrolled in their programs. It shows that there is a total of 530

TABLE 6—Current (fall 1975) undergraduates and graduates with declared forensic science majors.

Student Level	Undergraduate Students, no.	Graduate Students, no.
Freshman	187	...
Sophomores	140	...
Juniors	115	...
Seniors	88	...
Masters	...	210
Doctorate	...	4
Total	530	214

forensic science undergraduate majors in the various programs around the nation. In addition, there are 210 students currently enrolled in masters programs and four actively pursuing the doctoral degree. It can also be seen, particularly at the undergraduate level, that there is a steady increase in enrollment from the senior to the freshman level. That is, there are approximately twice the number of freshmen in all programs than there are seniors. The schools reported that they anticipate 90% of the declared forensic science majors will complete their degrees successfully, which should result in at least a doubling of graduates in the next three to four years.

It is of interest to determine what has become of the individuals who have received degrees in forensic science up to this time. Table 7 shows that most graduates end up working primarily in state and local forensic science laboratories. Others have taken positions

TABLE 7—*Holders of forensic science degrees who are employed in the field.*

Type of Position	B.S.	Graduate	Total
Forensic science laboratories			
Local	56	96	152
State	44	94	138
Federal	5	60	65
Private	11	2	13
Other	15	10	25
Laboratories outside forensic science	29	24	53
Teaching (full-time)	11	10	21

in federal or private laboratories, colleges or universities, or jobs outside the forensic science field altogether.

One should note that these data do not reflect the fact that many graduate students are already employed in a forensic science laboratory and therefore do not constitute new entries into the forensic science profession as they receive their degrees and continue their employment in the same laboratories.

Another one of the basic purposes of this study was to describe the facilities, laboratories, and equipment available at each of the institutions. The schools were also asked how many teaching and research laboratories were dedicated to the forensic science program. Of those that responded to this question, the mean value was 2.2 teaching laboratories and 0.9 research laboratories per institution. While most programs had darkrooms and stockrooms either dedicated or available to forensic science students, only 37% maintained cold rooms (see Table 8).

TABLE 8—*Institutions having specialized facilities (n = 19).*

Facility	Number	Percent
Laboratories ^a		
Teaching	19	100
Research	10	52
Darkroom	15	79
Stockroom	10	52
Cold room	7	37

^aMean value = 2.2 teaching laboratories and 0.9 research laboratories per institution.

The schools were also asked to list the specialized equipment dedicated to the forensic science program, not including items such as student microscopes. As illustrated in Table

9, of the 15 schools which supplied information, 87% have at least a single comparison microscope, 93% have polarizing microscopes, 93% have ultraviolet-visible spectrophotometers, 80% have infrared spectrophotometers, and 87% have at least a single gas chromatograph. Many of the schools possess other refined instrumentation, including

TABLE 9—*Forensic science institutions having direct access to specialized instrumentation (n = 15).*

Instrumentation	Institutions with Capabilities	
	Number	Percent
Microscopy		
Comparison	13	87
Phase contrast	8	53
Polarizing	14	93
Electron (scanning)	5	33
Hot stage	3	20
Ultraviolet visible spectrophotometry	14	93
Gas chromatography	13	87
Infrared spectrophotometry	12	80
Atomic absorption spectroscopy	8	53
Electrophoresis	7	47
Spectrophotofluorometry	7	47
Emission spectroscopy	5	33
Gas chromatography/mass spectrometry	5	33
Refractometry	4	27
Nuclear magnetic resonance	4	27
High pressure liquid chromatography	4	27
Mass spectroscopy	3	20
Electron spin resonance	2	13
X-ray diffraction	2	13
Differential thermal analysis	1	7

atomic absorption, mass and emission spectrographs, and electrophoresis. It seems clear that most institutions already have, or are in the process of procuring, the essential instrumentation with which students of forensic science should be familiar.

Five of the 11 graduate programs and 11 of the 15 undergraduate programs responding have some type of internship program established with a working crime laboratory (see Table 10). Seven of these internship programs are elective and nine are mandatory for graduation. Eighty-five percent of the institutions that have internships give academic

TABLE 10—*Forensic science internships (n = 13).*

Degrees Offered	Internship		
	Elective	Mandatory	Total
B.S.	4 (36%)	7 (64%)	11 (100%)
M.S.	3 (60%)	2 (40%)	5 (100%)
Total	7 (100%)	9 (100%)	16 (100%)

credit for the experience ranging from 3 to 14 units. Most of the schools rated their internship programs as "excellent" and feel that it is an essential component of their programs.

Perhaps no area is of greater concern to the forensic scientist in the working labora-

tory than the curriculum offered at each of the institutions. In a questionnaire of this type it is not possible to truly evaluate the curriculum at each of the institutions. Without examining lesson plans and laboratory workbooks or observing faculty in the classroom, it is inappropriate to appraise the quality of courses offered. It was possible, however, to gather basic descriptive information on credit hours required in various substantive areas and the scope of courses offered in the specialized forensic science/criminalistics area.

Table 11 presents the responses from 13 institutions and describes their basic requirements for an undergraduate degree. The requirements, which have all been converted to semester hours, reflect that all institutions require the equivalent to at least a minor in chemistry plus additional credit hours in biology, math, and physics. These courses constitute the first major category of requirements, providing the student with a basic foundation in the natural sciences. The second major concentration of required hours is in the area of criminal justice. The third area consists of specialized forensic science courses, which includes required internship semester hours. The curricular requirements vary from institutions that essentially define a forensic science degree as a concentration in chemistry and criminal justice to those which balance these requirements with an equal or greater number of credits in forensic science courses.

Table 12 presents the specialized forensic science course offerings of 16 schools which provided such information. It should be noted that this table combines all undergraduate and graduate courses (required and elective) offered by an institution and therefore favors institutions which possess both types of degrees. Although this table includes specialized course offerings in such subjects as drug analysis, microscopy, and scientific photography, the reader should be aware that core courses in criminalistics and instrumental analysis usually cover these topics at varying depths.

Table 13 displays the basic requirements for masters degrees in several graduate programs. All the schools except for Northeastern University and the University of California at Berkeley offer a thesis option whereby the student is not required to write a masters thesis but in its place writes a comprehensive examination, undertakes a special project, or takes additional course work.

Discussion

A critical juncture has been reached in the development of the criminalistics educational programs. While great advances have been made within the past five years in operating laboratories in terms of size, sophistication, and information exchange, educational institutions presently operate in isolation from each other. Although at the local level colleges and universities do interact with neighboring crime laboratories, there is no systematic or regular exchange of information among schools and laboratories at a national level.

Because the number of degree-granting institutions has doubled in the last three years, the problem of communication has been magnified proportionately. Now that a substantial number of programs are either fully operational or in the developmental stages throughout the country, a concerted effort must be launched to identify, define, and resolve the new problem areas which are bound to arise. The authors hope this survey will serve as an initial step in efforts to gather and disseminate information on all forensic science programs to the professionals in the field, to other educators, and to prospective students. The free flow of information is indispensable in the process of improved and increased professionalism.

Based on the results of this present survey and personal interaction with other educators and criminalists, the following conclusions have been formulated:

1. There has been a tremendous expansion of forensic science degree programs. The

TABLE 11—Undergraduate forensic science degree requirements (n = 13).

Institution	Required Semester Hours ^a							Total
	Chemistry	Biology	Physics/Math	Criminal Justice	Forensic Science ^b			
University of California, Berkeley	16	9	13	6	17		61	
Northern Arizona University	30	...	...	30	...		60
John Jay College	23	8	14	3	22(3)		70	
State University College at Buffalo	24	3	6	12	6(3)		51	
University of New Haven	28	11	16	18	31		104	
East Texas State University	39	16	14	...	6(6)		75	
California State, Sacramento	32	14	15	15	16		92	
Indiana State University	34	...	27	12	9		82	
Florida Technological University	21	9	18	6	16(5)		70	
Jacksonville State University	28	12	6	21	21		88	
Metropolitan State	40	19	9	11	21(14)		100	
University of Mississippi	23	7	20	3	38(5)		91	
Eastern Kentucky University	30	3	13	6	18(6)		70	

^aRequirements at institutions on the quarter system have been converted to semester hours (one quarter hour = 2/3 semester hour).

^bIncluded in parentheses are the semester hours of a required internship that are included in the preceding figure.

TABLE 12—Number of graduate and undergraduate course offerings in forensic science (n = 16).

Institution	Intro. to Forensic Science	Criminalistics/Microanalysis	Instrumental Analysis	Serology/Immunology	Toxicology	Drug Analysis
University of California, Berkeley ^a	1	2	1	3	1	...
California State, Los Angeles ^b	...	3	...	...	...	1
Northern Arizona University ^a	...	1	2	...	...	...
John Jay College ^a	1	4	4	1	1	...
University of Pittsburgh ^b	1	2	...	2	...	2
State University College, Buffalo ^c	...	1	...	...	...	...
University of New Haven ^c	1	2	1	1	1	...
East Texas State University ^a	...	...	2	...	...	...
California State, Sacramento ^c	1	2	1	...	...	...
Indiana State University ^c	...	1	1	1	...	...
Florida Technological University ^c	...	2	1	2	...	...
Jacksonville State University ^a	1	4	1	1	3	2
Metropolitan State ^c	...	1	...	...	...	...
University of Mississippi ^c	1	2	1	1	1	1
Eastern Kentucky University ^c	...	...	2	1	1	...
Northeastern University ^b	...	2	2	...	1	3

^aBoth graduate and undergraduate courses.

^bGraduate courses only.

^cUndergraduate courses only.

TABLE 12—Continued.

Institution	Forensic Medicine/ Pathology	Scientific Photography	Forensic Science Seminar	Microscopy	Crime Scene Investigation	Legal Aspects of Forensic Science
University of California, Berkeley ^a	1	...	1	2	...	...
California State, Los Angeles ^b	1	...	1	...	...	...
Northern Arizona University ^a	...	...	...	...	...	...
John Jay College ^a	...	...	2	...	...	...
University of Pittsburgh ^b	...	...	...	...	...	1
State University College, Buffalo ^c	...	...	...	...	...	...
University of New Haven ^c	2	1	...	...	...	...
East Texas State University ^a	...	...	...	...	...	...
California State, Sacramento ^c	...	...	...	...	1	2
Indiana State University ^c	...	...	...	...	...	...
Florida Technological University ^c	...	...	...	...	...	...
Jacksonville State University ^a	2	1	1	...	...	1
Metropolitan State ^c	...	...	1	...	...	...
University of Mississippi ^c	...	1	...	1	...	1
Eastern Kentucky University ^c	...	1	1	1	...	...
Northeastern University ^b	...	...	1	...	1	1

^aBoth graduate and undergraduate courses.^bGraduate courses only.^cUndergraduate courses only.

TABLE 12—Continued.

Institution	Questioned Documents	Arson/Explosives	Soil Analysis	Firearms/Toolmarks	Internship	Other	Total
University of California, Berkeley ^a	1	2	15
California State, Los Angeles ^b	1	...	...	...	...	1	8
Northern Arizona University ^a	1	...	4
John Jay College ^a	1	...	14
University of Pittsburgh ^b	...	1	...	...	1	1	11
State University College, Buffalo ^c	1	...	2
University of New Haven ^c	1	1	11
East Texas State University ^a	1	...	3
California State, Sacramento ^c	1	1	9
Indiana State University ^c	3
Florida Technological University ^c	1	1	7
Jacksonville State University ^a	1	...	1	1	1	1	22
Metropolitan State ^c	1	1	4
University of Mississippi ^c	1	...	1	1	13
Eastern Kentucky University ^c	1	...	...	...	1	1	10
Northeastern University ^b	...	1	...	...	1	1	14

^aBoth graduate and undergraduate courses.

^bGraduate courses only.

^cUndergraduate courses only.

TABLE 13—Requirements for the masters degree.

Institution	Basic Requirements For Admission	Graduate Semester Hours Required	Thesis	Alternative to Thesis
Michigan State University	B.S. in natural or physical sciences	35	optional with oral	additional credits plus written comprehensive
University of California, Berkeley	B.S. in physical and natural sciences	20	mandatory	...
California State, L.A.	B.S. in chemistry or equivalent	30	optional	additional courses
Northern Arizona University	B.S.	36	optional	additional courses
George Washington University	for the M.S. program: B.S. in biological or physical sciences for the M.F.S. program: B.S. in behavioral, biological or physical sciences; law, medicine	36	optional	written comprehensive examination required
John Jay College	B.S. in chemistry or equivalent	30	optional	one year laboratory research project
University of Pittsburgh	B.S., concentration in chemistry	30	optional	additional courses to total 30 credits
Northeastern University	B.S. in physical or life sciences	28	mandatory	...

individual programs have not been coordinated nationally; they reflect primarily the academic specialties, philosophies, resources, and needs of the local community.

2. While many of the programs possess faculties with both specialized training and experience in the forensic science field, others do not and depend entirely on adjunct faculty for professional expertise. Faculty members are making sincere efforts to gain this experience during sabbaticals and through ongoing working relationships with laboratories. The use of adjunct lecturers is quite acceptable for the teaching of specialized courses but cannot take the place of dedicated, qualified, full-time faculty.

3. The number of students majoring in forensic science is increasing at a rapid rate each year at both the undergraduate and graduate levels. Accordingly, the number of new graduates who will be in the market for jobs in the professional field will be increasing rapidly.

4. The demand for new forensic scientists is not accurately known. A recent survey of the crime laboratories in California projects a 10 to 12% annual growth rate for the period 1975 to 1980. This would translate into a demand for 200 to 250 new forensic scientists per year on a national level. The recently completed Forensic Sciences Foundation Study estimates an 8% growth rate during the next four years. Although the former estimate may be excessive and the latter too conservative, together they illustrate that we simply do not know what the actual demand for new forensic scientists will be in the coming years.

5. Although the primary objective of all degree programs is similar, the capabilities of graduates from the respective institutions are not uniform. Laboratories are forced to evaluate each graduate individually to determine his suitability for a given position.

6. The numbers of bachelors and graduate programs in the country are comparable. It is not possible at present to judge the relative utility of a B.S. degree versus an M.S. degree.

7. In the opinion of the authors and all educational institutions in the forensic science field, a degree in forensic science is superior to a conventional degree in chemistry or in another natural science. The advantages are numerous: the forensic science major has selected his field and has demonstrated the motivation and ability to handle such a curriculum; he may have completed course work in such areas as law, evidence, ethics, and criminal investigation which will speed his transition into the field; he has acquired basic scientific concepts with an emphasis on forensic science applications; and perhaps most important, he has developed a forensic science ethic or way of thinking which is unique to this particular profession. No institutions claim to graduate expert witnesses. They acknowledge that the student will have to undergo a period of orientation and on-the-job training.

8. A few institutions have developed criminalistics degree programs which are essentially dual majors in chemistry and criminal justice. The authors consider such programs to be inadequate since they do not include core laboratory courses in the proper recognition, identification, individualization, and interpretation of physical evidence.

9. Many scientists in criminalistics laboratories do not have specialized degrees in forensic science. Some have become qualified forensic scientists through experience and self-education, while others should be encouraged to enroll in advanced degree programs for specialized instruction in areas with which they are unfamiliar. Their enrollment will contribute to the quality and relevancy of academic programs and will enable them to share their practical knowledge with other students lacking this experience.

10. Teaching environments should be avoided where experienced forensic scientists serving as adjunct faculty are teaching courses where their own employees make up the majority of students. It is far healthier for universities to remain unattached from the policies and preferred methods of established laboratories. Ideally, educational institutions should introduce students to a variety of alternative procedures so that the graduate

can possess a broader perspective upon entering the field. Just as laboratories themselves can become stagnant from teaching only well-established methods to all new employees, universities can foster a similar condition where students only learn the techniques and philosophies of their supervisors.

11. Based on the responses from the survey it appears that most universities already have or are well on the way to having laboratories and instrumentation which are consistent with the state of the art in the forensic science field.

12. Most colleges and universities should launch more active recruitment efforts to attract the most promising students into their programs. When questioned, institutions reported that most students fell into the "above average" category but that very few could be rated as "excellent." The profession needs to recruit the very best undergraduate science students.

13. The faculty surveyed believes their students to be well prepared for entry into the field. This is not totally consistent with the feedback from some laboratories which have been less than satisfied with newly graduated recruits. Measures should be taken to improve feedback from the laboratories to the schools to insure that the curriculum is not only comprehensive from an academic standpoint but also meets the practical requirements of operating laboratories.

14. Because of the increasingly complex role of the forensic scientist in the criminal justice system, universities must be capable of offering more courses in areas such as the ethical obligations of the forensic scientist; the delivery of expert testimony; the proper techniques of managing large-scale scientific operations; and the means for documenting and measuring laboratory impact on the investigation and adjudication of criminal cases. Educational institutions must also keep abreast of all the latest developments in the field derived from current research publications, journals, professional meetings, and contacts with other forensic scientists.

15. Internships are an essential part of the forensic science education programs and should be given careful attention. They should be mandatory for all undergraduates and for graduates who lack practical experience.

16. Student research is an important component of forensic science education and, depending on the advancement of the student, should be encouraged and incorporated into the student's course of study.

Recommendations

As a result of this study of forensic science education in the United States, the following recommendations are offered:

1. Working laboratories must cooperate in undertaking a manpower-need assessment within the next year.

2. Efforts must begin immediately among educational institutions to discuss the standardization of curricula offerings.

3. The bachelors and masters degrees in forensic science must be differentiated in terms of capabilities of graduates and relative utility in the job market.

4. The growth of new programs should be discouraged until a determination of need is made.

5. Minimum academic and experiential qualifications should be established for forensic science instructional staff.

6. The possibility of accreditation of institutions should be explored.

7. The research capabilities of educational institutions should be strengthened to serve as a valuable resource to the profession.

Acknowledgments

The authors express their sincere appreciation to the schools that participated in this study for their cooperation. We also wish to thank Michael Heavey, Regina Kwan, and Elizabeth Taylor for their assistance in compiling the data and preparing the manuscript for publication.

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