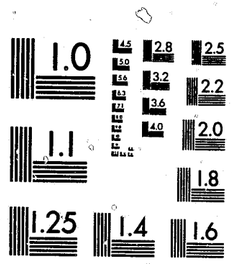

FORENSIC SEROLOGY WORKSHOPS

Final Report

78NI-AX-0079

FORENSIC SEROLOGY WORKSHOPS

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FORENSIC SEROLOGY WORKSHOPS

Final Report

September 1979

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For: Forensic Sciences Foundation, Inc.
Rockville, Maryland

Prepared for:

NATIONAL INSTITUTE OF LAW ENFORCEMENT AND CRIMINAL JUSTICE
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Washington, D.C. 20531

Attention: Mr. John O. Sullivan
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Grant No. 78NI-AX-0079

FSF Project No. 78-2

Approved By:

Kenneth S. Field
Executive Director

This project was supported by Grant Number LEAA 78NI-AX-0079 awarded to the Forensic Sciences Foundation by the National Institute of Law Enforcement and Criminal Justice, U.S. Department of Justice, and subcontracted to the Serological Research Institute. Points of view or opinions stated in this document are those of the authors and do not necessarily reflect the official position or policies of the U.S. Department of Justice.

ABSTRACT

The Forensic Serology Workshops Project was initiated to transfer the technology developed out of the Bloodstain Analysis System (J-LEAA-025-73, Subcontract 67854) to the nation's crime laboratories. To transfer this advanced training to forensic serologists nationwide, seven training workshops were held during the period August 1, 1978 to August 10, 1979. Ninety-four serologists from 40 states participated in the training, learning to use eight enzyme and protein polymorphisms through a multisystem electrophoresis process. The purpose of the project was to enhance the capability of the crime lab serologist to process blood evidence in a timely and efficient manner. The stated goal of the project was to train 100 forensic serologists in the Bloodstain Analysis System and to determine the quality of the training of the serologists through follow-up proficiency testing.

As elaborated in the final project report, more than 90% of the students characterized the overall value of the workshops and the quality of instruction as positive. Workshop administration, course preparation, training design and results of the follow-up proficiency testing are also detailed in the final report.

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ILLUSTRATIONS

PREFACE

This work was performed by the Serological Research Institute under subcontract to the Forensic Sciences Foundation, principal grantee for LEAA Grant #78NI-AX-0079. The project was initiated in August of 1978 and completed in August of 1979. The specific goal of the project was to set up a training course which would transfer the newly developed Bloodstain Analysis System to one hundred forensic serologists working in crime laboratories throughout the nation. To provide strong technical support to the project, the Forensic Sciences Foundation subcontracted to Serological Research Institute whose Director, Brian Wraxall, had been primary in the development of the Bloodstain Analysis System (J-LEAA-025-73). Also on the staff of the Serological Research Institute was Gary Harmor, who was instrumental in the development of the technology as Staff Research Assistant to the Bloodstain Analyis System Project.

The site used for the training was the Serological Research Institute's training laboratories and facilities. The actual training was performed by Brian Wraxall and Gary Harmor. Technical support in the preparation of proficiency testing samples (blind trials) was provided by staff serologist Joan Provost. Administrative and organizational support was provided by Kathy Jordan. Overall project administration was provided by the Forensic Sciences Foundation Director Dr. Joseph Peterson and Project Manager Ira Silvergleit.

EXECUTIVE SUMMARY

The Forensic Serology Workshops training program was intended to permit transfer of the newly developed technologies from the previously funded LEAA Bloodstain Analysis System program to crime laboratory personnel from across the nation. To ensure the use and accuracy of the methodologies learned at the workshops and incorporated by workshop participants into their home laboratory routines following the training, the project entailed a follow-up student proficiency testing program.

The plan for achieving the program goals was based on a cooperative effort between LEAA, the Forensic Sciences Foundation (principal grantee), the Serological Research Institute (subcontractor) and the participating laboratories. Under this cooperative plan, tuition and 80% of the travel and lodging expenses were supplied by LEAA. Project administration was provided by the Forensic Sciences Foundation. The participating laboratories furnished 20% of the travel and lodging expenses, the equipment required to utilize the methodologies within their laboratories after training, and finally, the serologist's time to participate in the training. The actual training was provided by Serological Research Institute.

The projected value of the project was the incorporation of the Bloodstain Analysis System into crime laboratories, enabling simultaneous determination of eight genetic markers in bloodstains aged up to four weeks, using a minimum of equipment and serologist-time, and thus raising the level of forensic serology to an advanced level of proficiency.

The evaluation phase of the workshops consisted of an evaluation of the workshops in general plus a series of blind trial samples mailed to participants. More than 90% of the students described the overall value of the workshops and

the quality of instruction as positive. Pre-and post-course examination results for the classes showed net improvements ranging from 14% to 41%. The results of the follow-up blind trial tests revealed no errors in the EsD, PGM, AK, or Gc systems and very few errors in the relatively new GLO system, a rare varient in the ADA system, and in the Hp system.

It is apparent from these results that a substantial degree of learning occurred as a result of these workshops and that the students were most satisfied with the quality of the workshops and the instructors.

CHAPTER I. COURSE PREPARATION

A. Applications

Applications and accompanying materials were prepared and distributed to crime laboratories listed in the American Society of Crime Laboratory Directors. The information outlined the cooperative nature of the project, the requirements for participation (financial, and regarding the equipment and the availability of the serologist) and a description of the training course. By September 1978, 115 applications had been returned. These were separated into "experienced" and "inexperienced" classifications and scheduled into specific workshops. Courses were divided by experience, with serologists having a year's experience with three or more enzyme systems falling into the experienced category. Serologists with less experience were classified as "inexperienced." The courses for experienced serologists were scheduled for two weeks with the courses for inexperienced serologists lasting three weeks. Applicants were notified of acceptance and given the dates for their training. Verification was made regarding the availability of the necessary equipment and supplies in the home laboratory.*

B. Pre-Workshop Materials

Each student was sent a reading list containing books, articles and other reading materials covering theoretical and practical background information on electrophoresis and the typing of enzymes and proteins to be used in the training workshop (Appendix A). Students were informed that the material would be covered in a pre-course examination shown in Figure 1. Supply lists were sent to students to assist in the purchase of laboratory chemcials and biochemicals to perform

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*It was found that some students did not have the necessary equipment when they attended the course even though they indicated to the contrary on their application form.

FIGURE 1: Pre-Course Examination (Experienced)

1. What is the definition of electrophoresis?

2. What are the three common phenotypes of ADA and give the approximate percentage for white Caucasians?

3. Draw out the reaction pathway for PGM.

4. Describe two methods for enhancing the florescence of EAP.

5. The mobility of one phenotype of EAP is altered by the addition of a certain chemical to the buffer. What is the chemical and what is the phenotype? In what direction is the mobility altered?

6. EAP isozymes are heat labile. List the isozymes in the order of heat sensitivity, listing the least sensitive first.

7. Name two reducing agents as used in forensic serology and list the genetic markers which require their use.

8. Name one method for the quantifying Hp in serum. Which phenotype has the lowest level of activity?

9. What is the function of Gc in the body? Name three rare variants of Gc.

10. What are the three common phenotypes of GLO I and describe two methods of visualizing the enzyme?

11. Name two substrates for EsD.

12. What is another name for Adenylate Kinase?

13. In the ADA system what is the substance Adenosine converted to?

14. Describe the principle of immunofixation.

15. Write out the correct nomenclature for a PGM 2-1 Atkinson.

the techniques in the home laboratory after training. The lists included all chemicals and biochemicals needed for the Bloodstain Analysis System, grade and quality recommendations, suppliers and product numbers for ordering.

A suggested list of personal equipment was sent to students recommending those small laboratory tools they might wish to bring to the workshop for use during training (tweezers, notebooks, lab coat, etc.)

C. Training Dates

The training workships were scheduled to allow time between the courses for inventory of equipment and supplies, reordering and stocking, laboratory clean-up, review of the courses as they were completed and planning for the next courses.

The training dates were as follows:

Workshop I	(experienced)	Nov. 6 to 17, 1978
Workshop II	(inexperienced)	Jan. 8 to 26, 1979
Workshop III	(experienced)	Feb. 26 to Mar. 9, 1979
Workshop IV	(inexperienced)	Mar. 19 to Apr. 6, 1979
Workshop V	(experienced)	Apr. 23 to May 4, 1979
Workshop VI	(inexperienced)	June 4 to June 23, 1979
Workshop VII	(mixed)	July 23 to Aug. 10, 1979

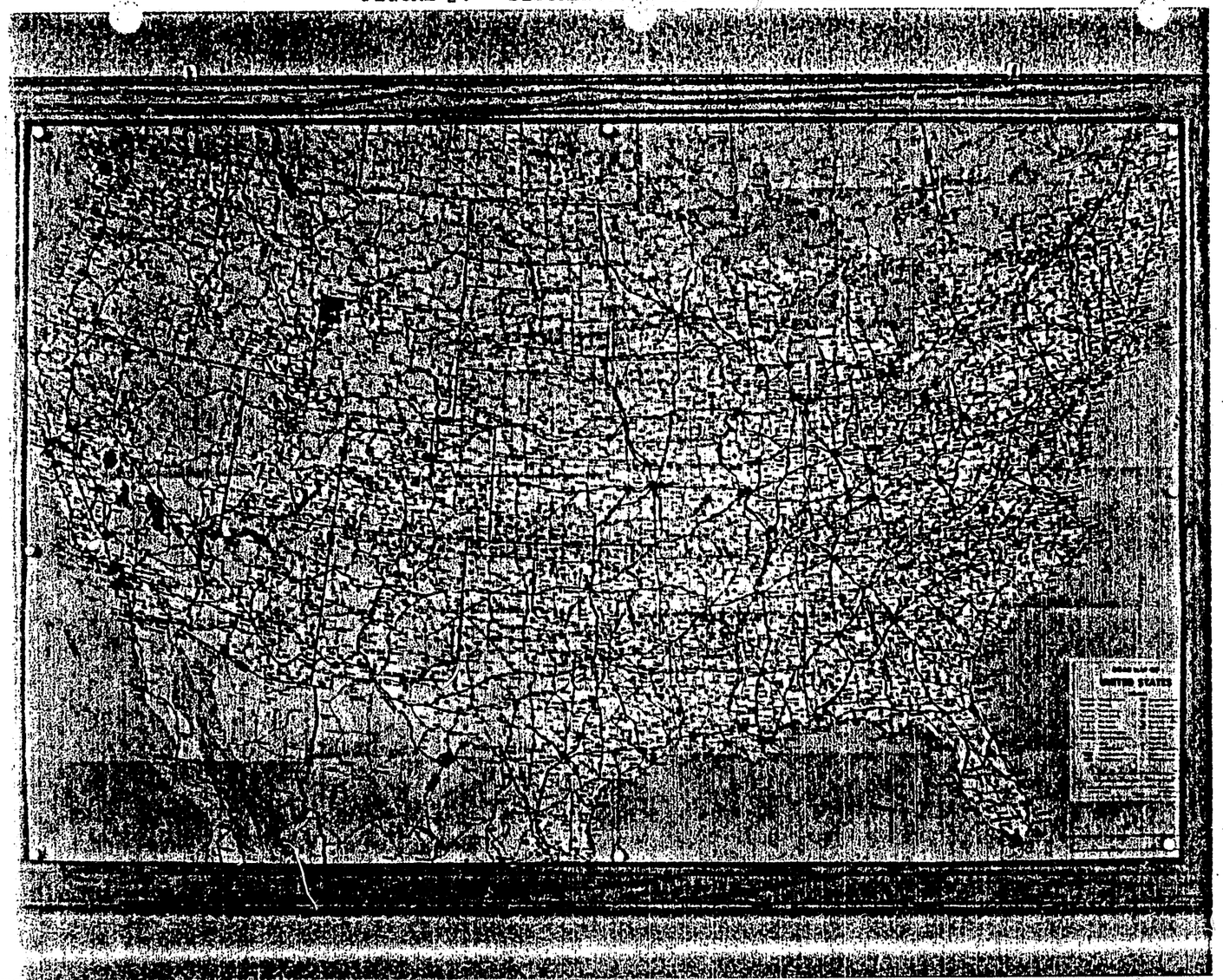
The final course, Workshop VII, was made up of both experienced and inexperienced serologists in an effort to accommodate as many of the remaining applicants as possible. Each workshop was planned to include fifteen students. Due to the insufficient time prior to the first course, all students attending this workshop were contacted by telephone to ascertain their availability. For subsequent courses a letter was sent to all prospective students giving them notice of the date of their course. A large number of students did not reply confirming their acceptance. Follow-up telephone calls were completed and it was found

that many applicants could not be released to attend the workshops because of financial reasons, high case load, or they could not be spared from the laboratory. Some were awaiting permission from their organizatons. (This was often not granted.) Inevitably, this resulted in considerable rescheduling of students and rearangement of courses. Personal committments and court appearances, and agencies suddenly withdrawing funds also caused last minute cancellations. Even though "stand-by" applicants were used, the difficulties encountered resulted in some courses being under-subscribed.

D. Attendance

Ninety-four serologists representing 40 states attended the workshops. The distribution of laboratories represented is shown in Figure 2.

FIGURE 2: DISTRIBUTION OF LABORATORIES



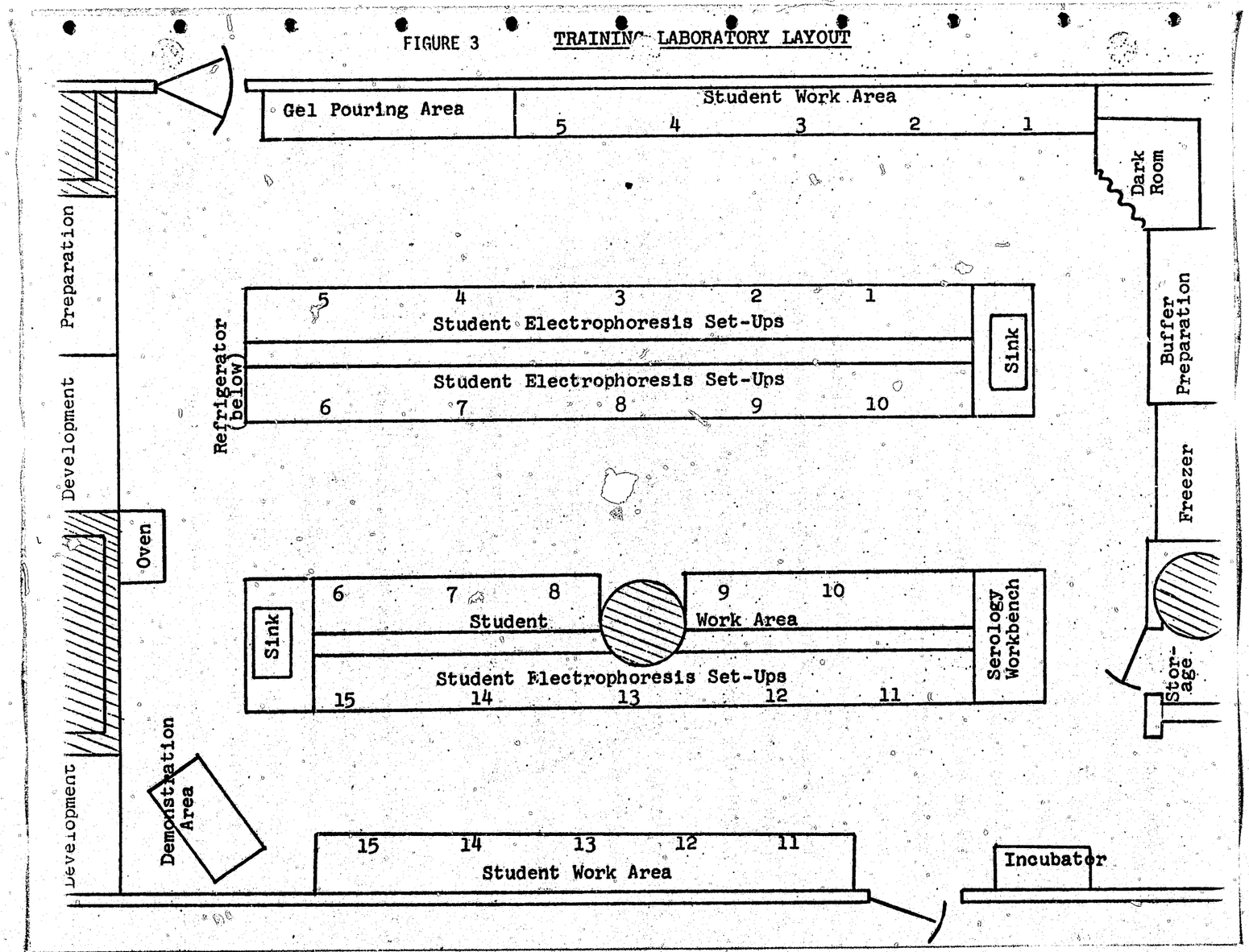
CHAPTER II. FACILITIES PREPARATION

The Serological Research Institute occupies a section of the building that formerly housed Shell Oil's Research Facilities in Emeryville, California. The facilities include a large training laboratory, a small research laboratory, darkroom, library/conference room and administrative offices. The large training laboratory was renovated to accommodate the workshops involving up to 15 students, allowing each student an individual work area. The design of the laboratory was focused on the efficient use of space and equipment and the needs of the students who would be trained there. Laboratory benches were installed, along with cabinets and two large stainless steel sinks with hot and cold water. The laboratory was cleaned and painted and all utilities were tested to be working safely and efficiently. A darkroom was built into the laboratory and equipped with ultra-violet and visable light facilities. Each student "work area" was equipped with electrophoretic equipment, as well as bench space for individual work. Equipment that was to be shared by the students, such as refrigerators, ovens, balances, etc., was strategically placed in open areas of the laboratory to provide access by all students (See Figure 3.)

Serological Research Institute made contact with numerous scientific supply companies and in most cases was able to arrange purchase of equipment and supplies in bulk at a substantially reduced price. Equipment which was unavailable through conventional sources was modified or manufactured for Serological Research Institute specifically for the training workshops.

All necessary equipment and supplies were in-house and ready for use at the time of the first course. Due to the need for fresh chemicals and biochemicals, and the unavoidable breakage of glassware, these supplies were purchased throughout the duration of the project, and additional equipment was purchased when

FIGURE 3 TRAINING LABORATORY LAYOUT



experience showed the need for the addition of specific items.

Information regarding the necessary equipment and supplies to be purchased by the participating laboratories was distributed by Serological Research Institute. The availability of this equipment was a requirement for the participating laboratories to ensure that the student would be able to perform the new techniques upon his return to his home laboratory. Specifications, grades and qualities were researched by Serological Research Institute and recommendations were forwarded to the students prior to the workshops. In addition, a list of suppliers was compiled and personal assistance given to aid in the procurement of the necessary equipment and supplies. The contacts made in purchasing for the training laboratory proved valuable in assisting the participating laboratories with their purchasing.

The library/conference room at Serological Research Institute was converted to double as a classroom/lecture hall including facilities to show slides and provide visual aids to learning. The darkroom was set up to allow students to view their results under ultra-violet or visable light and to photograph results as necessary.

Contact was made with hotels and motels in the area to locate lodging facilities that could also provide transportation to and from the training site and box lunches for working days. A contract was made with a local hotel which provided the above services and also offered a weekly rental rate that was considerably less expensive than any other local facility. Block reservations were made for each course to allow the students to focus on the training aspect of their visit without having to make arrangements for their lodging and local transportation. The hotel van delivered students to the training site each morning and returned them to the hotel each evening. Any problems that arose were directed to the Serological Research Institute staff for negociation with the hotel.

After each course, inventory was taken in the training laboratory. Supplies of chemicals and biochemicals were checked and when necessary, reordered for the next course. Glassware and other expendable supplies were reviewed and replaced when necessary. All equipment was checked to ensure its proper operation and cleaned. Some equipment pieces were found faulty and were returned for warrantee replacement.

Problems in regard to shared equipment precipitated the addition of an extra balance and magnetic stirrer, and a hot water supply was added to the second sink. With these additions the facilities proved very satisfactory for the courses. The layout of the training laboratory is shown in Figure 3.

CHAPTER III. TRAINING DESIGN

Each training course was designed to transfer the newly developed Bloodstain Analysis System (BAS) to each serologist. The BAS consists of eight polymorphic enzymes and proteins which are classified into groups. Group I consists of the enzymes Glyoxalase I (GLO I), Esterase D (EsD) and Phosphoglucomutase (PGM). Group II contains the enzymes Adenosine Deaminase (ADA), Erythrocyte Acid Phosphatase (EAP) and Adenylate Kinase (AK). Group III consists of the proteins Group Specific Component (Gc) and Haptoglobin (Hp). A summary of the BAS is shown in Figure 4.

The courses were designed as mainly practical with the students doing all the work themselves including buffer and solution preparation. Even though the students were divided into sets (see below) each was responsible for his own analyses. Each Group of enzymes or proteins was very carefully demonstrated and then the students performed repeat analyses of that Group System starting with whole blood samples and then progressing on to bloodstains of varying ages. A large emphasis was placed on the interpretation of the results with the instructors checking and reading the results with the student.

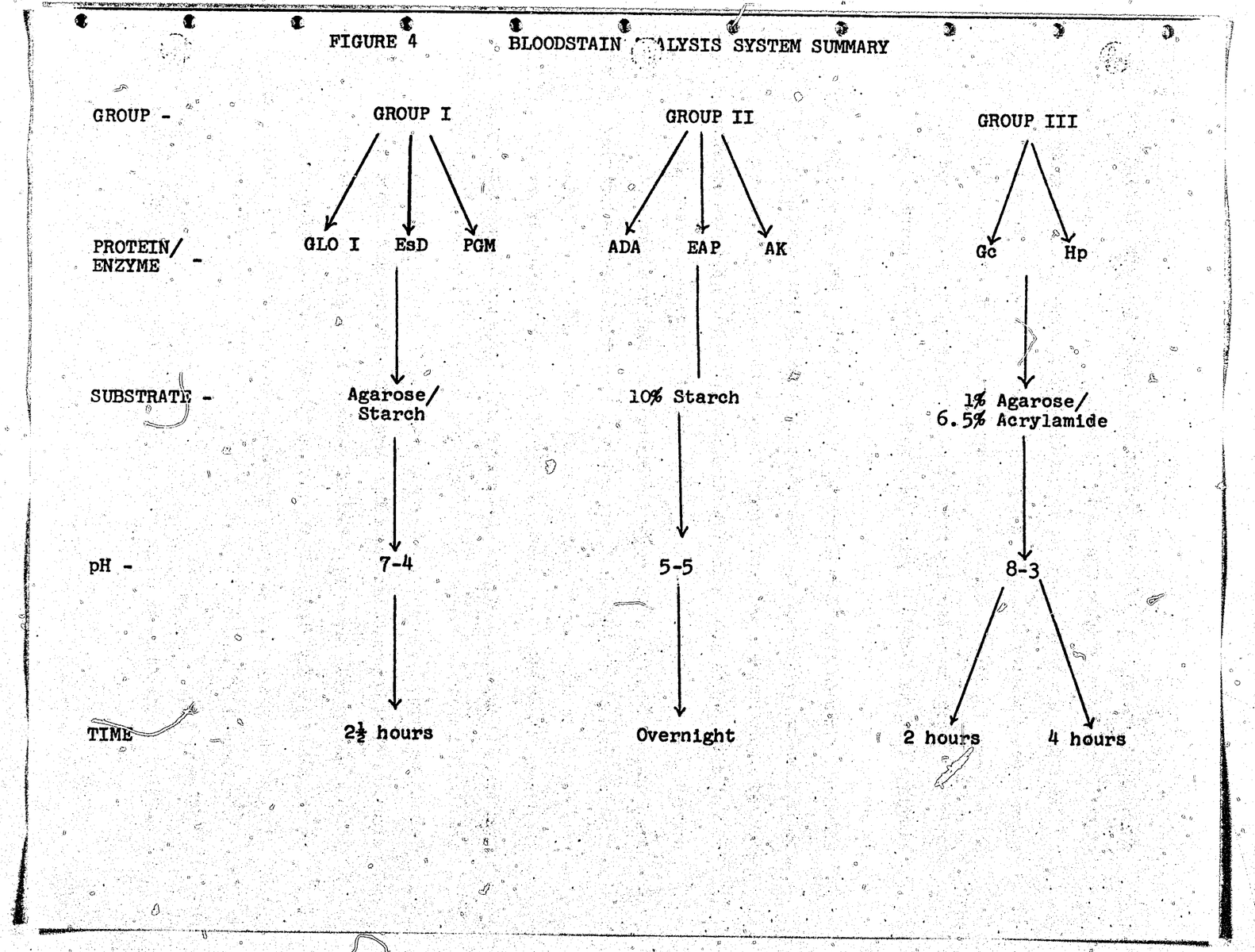
A. Workshop Manual

A workshop manual was designed (prior to the first course) which was to be given to every participating student. It was constructed as a practical aid divided into easily read sections with large amounts of space for note-taking. It was printed and bound into a loose leaf binder and distributed at the beginning of each course. A copy of the manual is attached as Appendix B.

B. Course Schedule

Having up to 15 students attending each course, it was desirable, even necessary, to have a well designed program to ensure the smooth, efficient running of each workshop. For the first course a rigid schedule was used which had been

FIGURE 4 BLOODSTAIN ANALYSIS SYSTEM SUMMARY



copied and given to each student at the beginning of the workshop. A copy of the first course schedule appears in Figure 5.

The course was divided into three sets of up to 5 students. Each set of students would start with a different Group System, i.e., Set A - Group I; Set B - Group II; Set C - Group III. In this way the set of students would master one Group System and then progress on to the next. This design had the advantage that there would only be 5 people working in any given area of the laboratory at the same time, making the use of laboratory equipment more efficient. It also allowed demonstrations to be given to smaller groups of students which, even though the instructors had to demonstrate repeatedly, ensured a more complete understanding of the techniques shown. These sets of 5 students proved very successful and were employed throughout the workshops. However, the rigid course schedule was not used in subsequent courses. It was found, particularly with inexperienced students, that some people are slow learners, particularly at first, and it is therefore desirable that they only move on to their second Group System when they had completely mastered the first. This proved to be much more satisfactory and although it was theoretically possible that some students may only learn one Group System, in practice the majority learned all three Systems easily. The occasional student learned two Group Systems very well while learning the third only partially. After the first course it was found that more demonstrations were needed and so this was adopted. Similarly, instead of having a review of the day's work at the end of the day, it was found that the following morning, before the start of laboratory work, was more desirable. This then became the schedule for the following six courses.

C. Examinations

Prior to attendance at the workshop a reading list was sent to each student

FIGURE 5 FORENSIC SEROLOGY WORKSHOP EXPERIENCED COURSE - 2 WEEKS

WEEK 1	A (1 - 5)	B (6 - 10)	C (10 - 15)
Monday		Welcome & Introduction Aims of the Course Assignment & House Rules Blood Sampling & Preparation	
	Group I Demonstration	Group II Demonstration Group II (1)	Group III Preparation
Tuesday	Group I (1)	Group II (2) Stains	Group III Demonstration Group III (1) Group II (1)
Wednesday	Group I (2) Stains Group II (1)	Group I (1)	Group III (2) Stains Group II (2) Stains
Thursday	Group II (2) Stains Group III (1)	Group III (1) Group I (2) Stains	Group I (1)
Friday	Group III (2) Stains	Group III (2) Stains	Group I (2) Stains
	Lab Clean-Up	Buffer Replacement	Evaluation

WEEK 2			
Monday	Group I (3) Blind Trial Group II (3) Blind Trial	Group II (3) Blind Trial Group III (3) Blind Trial	Group III (3) Blind Trial Group I (3) Blind Trial
Tuesday	Group III (3) Blind Trial Group II (4)	Group I (3) Blind Trial Group II (4)	Group II (3) Blind Trial Group III (4)
Wednesday	Group III (4) Group I (4)	Group III (4) Group I (4)	Group I (4) Group II (4)
Thursday	Group I (5) Blind Trial Group III (5) Blind Trial Group II (5) Blind Trial	Group I (5) Blind Trial Group III (5) Blind Trial Group II (5) Blind Trial	Group I (5) Blind Trial Group III (5) Blind Trial Group II (5) Blind Trial
Friday	Options on Group I & III, Evaluation, Summary & Conclusion		

Throughout the workshop there will be periodic sessions on interpretation of the genetic markers and integration of the methods into your own lab system.

asking them to obtain copies of the references and to familiarize themselves with the data therein. A copy of the reading list appears in Appendix A. This pre-course reading would hopefully ensure that all students would have access to the same bank of knowledge and therefore time would not have to be spent reviewing large areas of theory. A pre-course examination covering areas found in the literature was given. An example of the pre-course examination is found in Figure 1, page 2.

From the results it was obvious that many of the students had not read the suggested literature and more work was required by both students and instructors. However, in the majority of cases the post-course examination (Figure 6) showed a good understanding of the techniques taught and also a good improvement in their understanding of the theory. See Tables 7 and 8.

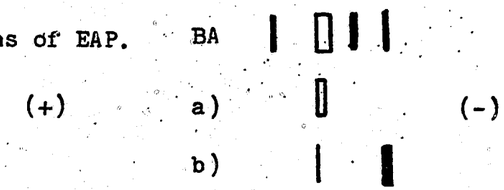
D. Blind Trials - In House

On the last few days of the course each student was given a set of 5 unknown stains made on cotton cloth ranging in age up to four weeks. They were asked to phenotype the stains in all eight systems and turn in their results for checking. Where errors were made the results were checked from actual completed plates or from photographs. Where possible the stains were reanalyzed. The results are shown in Table 9.

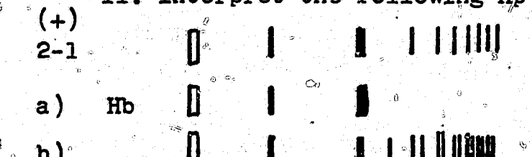
The number of questioned results or stains showing no activity equalled approximately 10% of the total readings. This is not abnormally high considering that most students had only been exposed to less than half of the Systems before coming to the course. The number of errors accounted for less than 1% of the total readings. These occurred in all Systems and were mainly as a result of misinterpretation of the phenotypes. Other errors occurred because rare varients were included (with which the students were unfamiliar) or because the wrong samples were applied. In all cases where the stains were repeated the

FIGURE 5: Post-Course Examination (Experienced)

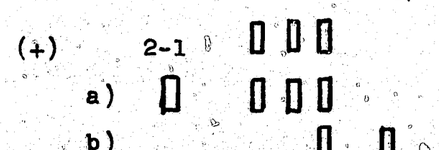
1. What rules do you use when interpretting EsD on stains? Draw the patterns if necessary.
2. Show the position of the pseudo d band on a PGM type 1.
3. Name the three varients at the PGM_2 locus.
4. What is the position of the storage bands on the three GLO phenotypes?
5. Give two causes for a clear (no bands) gel after staining for GLO.
   The EsD band is 8 cm from the origin. How would you "rescue" the plate?
6. Interpret the following patterns of EAP.



7. What is the population distribution of EAP in Caucasians?
8. Give one probable cause for: A) diffuse EAP bands.
   B) reddish purple bands in AK-I position.
9. What is the function of chloroform in extracting stains in Group III?
10. Why is acrylamide NOT used for typing Gc on stains?
11. Interpret the following Hp result:



12. Interpret the following Gc result:



13. Give two causes of non-polymerization of an acrylamide gel.
14. What is the remedy for halos around the Gc bands?
15. Have you enjoyed the course?

TABLE 7. SUMMARY OF EXAMINATION RESULTS

Course	Pre-Course Average	Post-Course Average	Net Improvement
I (experienced)	56.3%	(none given)	-
II (inexperienced)	30.8%	72.2%	+41.4%
III (experienced)	49.8%	81.4%	+31.6%
IV (inexperienced)	37.3%	64.7%	+27.4%
V (experienced)	58.4%	79.1%	+20.7%
VI (inexperienced)	54.8%	72.5%	+17.7%
VII (mixed)	52.0%	66.0%	+14.0%

TABLE 8. BREAKDOWN BY SCORES

Test Score	Pre-Course Exam	Post-Course Exam
91 - 100%	0 students	6 students
81 - 90%	4 students	18 students
71 - 80%	5 students	26 students
61 - 70%	13 students	11 students
51 - 60%	15 students	6 students
41 - 50%	11 students	9 students
31 - 30%	15 students	1 student
21 - 30%	5 students	0 students
11 - 20%	7 students	0 students
1 - 10%	3 students	*0 students

Table 8 reflects scores of Courses II through VII. Course I did not include a post-course examination, thus could not be compared.

*One student was recalled by his laboratory on the day of the exam.

TABLE 9. In-House Blind Trials

5 stains, 40 readings

Course	No. of Students	Age of Stains	No. of Readings	Correct	Incorrect	Questioned	No. Activity
I	15	1 - 4 weeks	600	490	8	37	65*
II	13	1 - 4 weeks	520	483	8	17	12
III	14	2 - 4 weeks	560	535	3	10	12
IV	12	1 - 4 weeks	480	377	8	59	36
V	15	1 - 3 weeks	600	511	4	20	65†
VI	13+	2 - 3 weeks	520	483	3	23	11
VII	11	3 days - 4 weeks	440	408	2	14	16
			3,720	3,287	36	180	217

* High number of "No Activity" due to the Group I Systems not working well in the first course.

† High number of "No Activity" due to the cotton cloth used on the Blind Trials.

\+ One student left early because he was required to make a court appearance and did not complete his Blind Trials.

Percentage Breakdown: 70 students scored 100% correct.
20 students scored 97.5% correct.
8 students scored 95% correct.

the correct phenotype was obtained.

It is interesting to note that in Course VII unknown stains were given to the students at the completion of each week of instruction and a final Blind Trial was given in the last week. The number of errors obtained was much lower than in many of the previous courses indicating that a series of Blind Trials is advantageous.

E. Training Design Summary

Each class divided into 3 sets of up to five students.

Each Group System demonstrated to each set of students with further demonstrations as required.

Each Group System worked for three to five days depending on whether the students were experienced or inexperienced. Review of previous day's work and results at the beginning of each day.

Culmination of the course with in-house blind trials.

CHAPTER IV. STUDENT EVALUATIONS

Evaluation questionnaires were prepared by the Forensic Sciences Foundation and distributed to all students attending the workshops on the last day of each workshop. The evaluations were completely anonymous. After review by the instructors the evaluations were forwarded to the Forensic Sciences Foundation for further review. Not all students replied to all questions, causing a variation in the number of responses to particular questions. The results of the evaluations are summarized below, along with a key to the scoring process.

A. Key to Scoring

Using a range of 1 through 7, students were asked to rate the workshop as follows:

1 to 3 = Poor or negative (1 being the lowest rating)

4 = Neutral

5 to 7 = Good or positive (7 being the highest rating)

B. Results

Question: What was the overall value of the serology training workshop to you?

Response: 85 students gave the workshops a positive rating (56 rated it 7, 25 rated it 6 and 4 rated it 5). One student rated the workshops 4 (neutral) and one student rated it 3 (poor or negative).

Question: How closely did the course meet your expectations of what it should be?

Response: 85 students rated positive (29 rated 7, 40 rated 6 and 16 rated 5). Two students gave ratings of 4 (neutral) and one student gave a rating of 3 (poor or negative).

Question: How well did the course cover knowledge and skills you feel it should have covered?

Response: 83 students gave the workshop a positive rating (29 rated 7, 34 rated 6 and 20 rated 5). Three students gave a neutral rating (4) and two students rated negatively (2).

Question: Has your confidence in yourself as a forensic serologist changed as a result of this training workshop? (Use 1 to 3 for negative change and 5 to 7 for positive change.)

Response: 71 students rated a positive change (19 rated 7, 33 rated 6 and 19 rated 5). Five students rated neutral on this question. Two students rated negative change (a 2 and a 1). There seemed to be confusion among the students concerning the meaning of the question.

Question: Rate your instructors' teaching ability.

Response: 87 students gave the instructors a positive rating (51 rated 7, 25 rated 6 and 11 rated 5). One student gave a neutral rating (4). There were no negative ratings.

Question: Rate your instructors' skills as serologists.

Response: 86 students gave the instructors a positive rating (69 rated 7, 14 rated 6 and 1 rated 5). Three students have neutral ratings (4). There were no negative ratings.

Question: Rate your instructors' knowledge of forensic serology.

Response: 83 students gave the instructors a positive rating (65 students rated 7, 18 rated 6). Three students gave a neutral (4) rating. Two students rated negatively (a 2 and a 1).

Question: Would you recommend this course to others in your laboratory?

Response: 76 replied YES. Three replied NO.

Question: What percentage of the material taught will you use when you return to your home laboratory?

91% - 100%	61 students
81% - 90%	15 students
71% - 80%	4 students
61% - 70%	2 students
51% - 60%	1 student
41% - 50%	1 student
30%	1 student

Question: How much have your serological skills changed as a result of this training workshop? If the course has helped you, choose a positive percentage. If not, choose a negative percentage. (For example: -25% = you are 25% worse, or +25% = you have improved 25%.)

Response:

+91 - 100%	9 students
+81 - 90%	2 students
+71 - 80%	9 students
+61 - 70%	4 students
+51 - 60%	none
+41 - 50%	25 students
+31 - 40%	3 students
+11 - 20%	11 students
+ 1 - 10%	7 students

There were no negative responses to this question.

Question: Was the grading fair?

Response: 74 students replied YES. There were no negative responses to this question.

Question: What did you like most about the course?

46 students replied: "The practical (hands-on, benchwork) experience."

16 students replied: "The helpfulness (knowledge) of the instructors."

13 students replied: "Learning new techniques (the BAS System)."

9 students replied: "The efficiency (smoothness, well planned) set up, operation and training at SERI."

6 students replied: "The opportunity to work on each Group System enough times to really learn."

6 students replied: "The positive atmosphere."

5 students replied: "Enough time (help) to learn."

4 students replied: "Emphasis on evaluating and interpreting results."

4 students replied: "Darkroom facility for photographing results."

4 students replied: "Learning with other serologists."

3 students replied: "The Training Manual."

2 students replied: "The (in-house) blind trails."

2 students replied: "Compatability of the experience level of the students."

Other aspects mentioned (once, each) were: Use of examples and demonstrations. Emphasis on accuracy and reproducibility. Practice on preparing gels, etc. Meeting other serologists. The feeling that it was O.K. to make mistakes while learning and ask questions.

Questions: What did you like least about the course?

20 students replied: "Not enough of certain equipment (pH meters, balances, etc.)."

15 students replied: "Not enough theory."

11 students replied: "Not enough time for the amount of material covered."

5 students replied: "The working day was too long."

3 students replied: "Three weeks was too long."

2 students replied: "The lack of organization (at SERI)."

2 students replied: "Not enough demonstration of rare types."

2 students replied: "The location (Hotel, Oakland/Emeryville)."

2 students replied: "Working in groups."

Other aspects mentioned by one student each were: Too much repetition of preparation steps. Not enough variety of stains and substrates. Running lysates and serum. Some of the students were sloppy (with chemicals, equipment). Not enough demonstrations. Equipment problems. Course wasn't basic enough. Pricking finger for blood.

Question: What suggestions do you have that might improve the course?

21 students replied: "More theory."

12 students replied: "More equipment (balances, pH meters, etc.)"

6 students replied: "More experience with rare variants."

5 students replied: "A more structured daily schedule."

5 students replied: "More time."

4 students replied: "Another darkroom."

3 students replied: "More Blind Trials throughout the course."

2 students replied: "More pre-course reading."

Other aspects mentioned once each were: Different concentrations of stains. More helpful hints in the manual. A more comprehensive examination. Fewer plates. Less material to cover. More demonstrations. More instructors. Make the students be more careful with equipment and chemicals. Hold the course in San Francisco.

Question: What topics or techniques would you like to see offered in future workshops?

20 students replied: "Isoelectric Focusing."

16 students replied: "SAP/VAP."

15 students replied: "More enzyme systems."

11 students replied: "Semen identification and typing."
11 students replied: "More on rape evidence."
9 students replied: "New developments, techniques."
9 students replied: "General beginner's course."
8 students replied: "Other body fluids."
7 students replied: "A course on theory."
5 students replied: "Race related variants."
2 students replied: "Immunoelectrophoresis."
2 students replied: "Trace evidence."

Other aspects mentioned once each were: Rh typing. Hair. Firearms and toolmarks. Analysis of red cell antigens on stains. Paternity work using the Multisystem. ABO and other antigens.

CHAPTER V. BLIND TRIALS - EXTERNAL FOLLOW-UP

A. Test Samples

Serological Research Institute hoped to supply eight unknown bloodstains to each student upon his or her return to the home laboratory for phenotyping in all eight systems. The LEAA grant monitor and SERI were negotiating to increase the number of follow-up tests by 22 stains through a supplementary grant to SERI which would have allowed the hiring of additional staff, to prepare the samples. Assuming that this grant was forthcoming, based on these negotiations, students from the first two courses received 11 and 10 stains respectively which was more than the 8 originally agreed upon. Subsequently, the grant application was rejected by NILECJ.

Consquently, 4 stains were sent to participants of Courses III and IV and no stains to Courses V, VI and VII.

B. Results

A summary of the results of the Follow-up Blind Trials is shown in Table 10. Not all students responded to the Blind Trials as sent out. The reasons for not replying are not altogether clear. Approximately 41% of students who applied and eventually were accepted did not have the necessary equipment at the time they applied. Although it was a condition of acceptance there were several instances of students admitting that their laboratory did not possess the necessary equipment at the time of their attendance at the workshop. We are aware of at least three students leaving their laboratory and moving into another job outside the field of forensic science. Some students we know were responsible for other areas in their laboratories besides forensic serology and the most usual reason for not responding was a high case load and insufficient time to devote to the blind trials.

TABLE 10. Blind Trials - External Follow-up

	No. of Readings	Correct Readings	Incorrect Readings	Questioned Readings	No Activity	Not Analyzed
Course I, SET 1 (15)* 11 responses, 5 stains each 1 to 3 weeks old	440	402	1	28	9	-
Course I, SET 2 (15)* 10 responses, 6 stains each 2 to 3 weeks old	480	380	1	55**	44**	-
Course II, SET 1 (14)* 8 responses, 6 stains each 2 to 3 weeks old	384	249	3	44**	88**	-
Course II, SET 2 (14)* 10 responses, 4 stains each 1 to 2 weeks old	320	295	0	15	6	4[T]
Course III, SET 1 (14)* 10 responses, 4 stains each 1 to 2 weeks old	320	269	4	23	8	16[T]
Course IV, SET 1 (12)* 5 responses, 4 stains each 1 to 2 weeks old	160	147	4	7	2	-

* Number in parentheses indicates the number of Blind Trials sets sent out to that course.

** High incidence of "No Activity" due to cotton/polyester cloth used. Found to be unsuitable.

[T] Not analyzed - Course II, Set 2: Gc not attempted yet.
Course III, Set 1: Lacked centrifuge, Gc and Hp not analyzed.

The most important point to consider in the responses are the errors. No errors were recorded in the EsD, PGM, AK or Gc Systems. Five mis-calls occurred in the Glyoxalase system which is, of course, relatively new to forensic serologists and the interpretation can be difficult. Four errors were made in the ADA system. Three students called the rare varient ADA 2 an ADA 2-1, a common mistake if one is not familiar with this rare type. Three errors occurred in the Hp system, all by the same person. In conversation with the student it was obvious that this was an interpretation problem as all these mistakes were the Hp type 2-1 being called a type 2. This like all other errors were checked and if possible the stain was reanalyzed by the student. In all cases it was possible to pinpoint the source of error and hopefully correct it.

It should be possible to observe an improvement in the error rate on subsequent Blind Trials. This is not observed in Course I as the error rate is low. However in Course II the error rate drops to zero in the second Blind Trial even though the number of responses is higher. Improvements in Courses III and IV cannot be evaluated because only one Blind Trial was sent out.

CHAPTER VI. RECOMMENDATIONS

This project has not been completed. Forty students have not received any proficiency samples (Blind Trials) since returning to their laboratories, and twenty-six students have only received one set of blind trials. This is unsatisfactory as one of the most important goals of this project has not been met.

The recommendations are as follows:

1. The follow-up testing program should be completed to ensure the use and accuracy of the methodology within the participating laboratories.
2. At the end of the last workshop there were still 95 applications for training in the Bloodstain Analysis System. Further funding should therefore be made available for training these serologists.
3. From the Evaluation section of the report it can be seen that other training courses in forensic serology are badly needed. As new developments in this area become available they must be transferred to the working crime laboratory. The most expeditious means of transfer is by training workshops. Therefore it is recommended that a program of training in basic and advanced serology be established.

APPENDIX A

PRE-COURSE READING LIST

SUGGESTED READINGS (Forensic Serology Workshops)

Handbook of Enzyme Electrophoresis in Human Genetics
by Harris and Hopkinson
(Chapters on PGM, EsD, GLO, EAP, AD, ADA)

The Examination and Typing of Bloodstains in the Crime Laboratory
by Brian Culliford
(Relevant chapters)

A Thin Layer Starch Gel Method
by Brian Wraxall
Journal of The Forensic Sciences Society - 1968, V.8 #2&3, 81-2

Phosphoglucomutase Polymorphism in Man
by Spencer, et al
(Nature 1964 V.204, 742)

Biochemical Methods in Red Cell Genetics
edited by J.J. Yunis
(1969) Chapters on PGM, EAP & AK

EsD in Bloodstains
by Parkin & Adams
(1975) Med. Sci.& Law 15, No. 2, 102-5

Esterase D Polymorphism
Hopkinson, et al
(1973) Ann. Hum. Genetics Laden 37, 119-37

Polymorphism of Red Cell Glyoxalase I
Kampf J., et al
Human Genetick 27, 141-3

Human Red Cell Glyoxalase I Polymorphism
Parr, et al
Biochem. Gen. (1977) 15, 1 & 2

EAP in Bloodstains
Wraxall & Emes
(1976) Journal of Forensic Sciences Society 16, 127-132

EAP in Bloodstains
McWright, et al
(1975) Forensic Science ASC Symposium Series, No. 13, 151

AK in Bloodstains
Wraxall & Culliford
(1968) Journal of Forensic Sciences Soc., V.8 #2&3, 79-80

Human Adenylate Kinase Polymorphism
Bowman et al
(1967) Nature 214, 1156-8

ADA - Reactive Sulphydryls in Enzymes
Hopkinson & Harris
(1969) Am. Hum. Genet. V.33, 81

Horizontal Polyacrylamide Electrophoresis
Hoppe, et al
(1972) Human Genetick V.14, 224-231

Varients of the Gc System by Immunofixation
Johnson, Cleve & Alper
Am. Journal Hum. Genet. V.27, 728

APPENDIX B

TRAINING MANUAL

BLOODSTAIN ANALYSIS SYSTEM

Procedures Manual

October 1978

Brian G. D. Wraxall

AN ORIGINAL COPY OF APPENDIX B HAS BEEN INCLUDED UNDER SEPARATE COVER AND IS NOT REPRODUCED IN THIS COPY.

Prepared for:

Forensic Serology Workshops

1977-78

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END