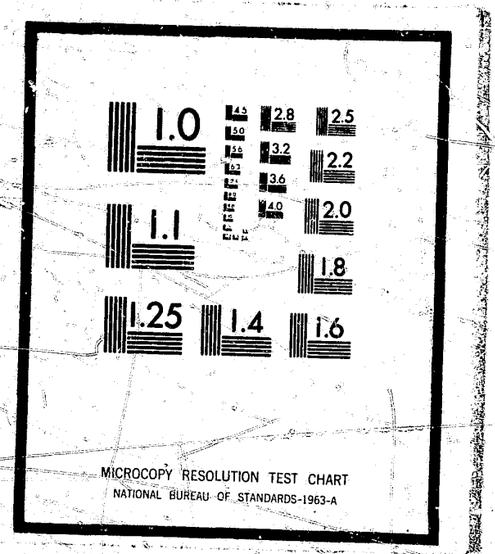

PHYSICAL EVIDENCE UTILIZATION in the ADMINISTRATION of CRIMINAL JUSTICE

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Introduction

In the law enforcement operation, the utilization of science and technology in providing proof for the physical links between a criminal and his crime has not been measured in any meaningful manner.[1,2,3,4] Those studies directed at present forensic science laboratories[1,2] offer little knowledge as to "how many known criminal violations could be constructively examined by scientific methods."[1] At the juridical level, it appears that "the scientific process stands at the periphery of the judicial fact finding inquiry, not integrated as it ought to be in every step of the investigative and prosecution process."[3] "The dearth of factual information on the decisions by which justice is weighed"[4] is particularly troublesome in relating the possible and potential use of science and technology to the needs of police investigation and strategy.

The study of Lassers' on murder cases provides some knowledge as to the engagement of scientific services.[5] That study was based on the assumption "that scientific evidence is more apt to be used in capital cases than in other cases." One hundred twenty-nine cases from across the nation in both state and federal appellate tribunals were examined in detail. These cases were taken from the years 1963, 1964, and 1965. On the further assumption that "almost every capital case is appealed," the study's conclusion would indicate "the extent to which the police and prosecution avail themselves of scientific techniques in ascertaining the identity of the criminal." Also, "if it appears that the police and prosecution do not make full use of current technology in death cases, then it seems a fair assumption that still less use is made of such methods in murder cases where the death penalty is not sought and in other non-capital criminal prosecutions." In 39 of these cases scientific evidence was offered which was taken to indicate "that the scientific process stands at the periphery of the judicial fact finding inquiry, not integrated as it ought to be in every step of the investigation and prosecution process." It was also concluded "that the defense almost never utilizes scientific evidence." While the major conclusion of peripheral status appeared reasonable, the 57 cases taken from "the 1963 data which is the most complete" represents only 0.6 of 1 per cent for the estimated occurrence of murder, i.e., about 3 out of every 500 homicides. The major conclusion may be a strong indication of scientific engagement in the prosecution process, but it is more difficult to interpret with respect to the investigative process.

In two reports dealing with investigation,[6,7] peripheral status would seem to be nonexistent. The first study was an examination of official records for a five year period of "suicide" cases. Among the 187 deaths, 64 cases involved notes, handwritten, printed or typed. Not one specimen of known writing or printing by a deceased was taken as evidence to compare against a "suicide" note. In fact, 176 deaths received no follow-up investigation of any kind according to the records. The second study on bus robberies discovered little utilization of physical evidence. As stated, "typically, the original case report made out by the uniformed patrol officer is the only document made out in the case." The

minimal gathering of physical evidence was concluded to be one aspect of "a system of 'selective neglect,' a system which is common in all sorts of occupations. Administrators -- and rank-in-file personnel, themselves -- may have a keen desire to do an outstanding job. Pressures, competing demands, lack of resources, lack of leadership or supervision, and countless other factors may manifestly interfere with the 'doing of the job,' however."

A detailed examination of one-fourth of all annual arrests made in Richmond, California, gave some information as to the connection between scientific crime laboratory services and the arrest decision.[8] The breakdown of arrests revealed 19% involved felonies and 44% involved misdemeanors with the remaining 37% involving warrants. With respect to the felony arrests, physical evidence collection occurred in two out of every three felonies, with more than half of these concerning illegal drugs. Other felonies in which physical evidence collections were made fell primarily into the two categories of burglaries and auto thefts. In these two later categories of felony arrests, physical evidence collections were made in about two out of three instances. For misdemeanors, approximately one in every twelve misdemeanor arrests involved the collection of physical evidence. It has been found in one examination of juvenile arrests for illegal drugs in the county including Richmond that"laboratory review" is a rarity[9]. Richmond, a city of approximately 89,000 population has nine evidence technicians among its 140 sworn officers. This large contingent of physical evidence collectors, along with the patrol and detective collections, may result in an above average rate for Richmond. Of additional interest are the collections related to drug violations; adult prosecution seems to necessitate actual laboratory analyses while juvenile prosecution seems to proceed on the basis of statements of admission.

In 1961, data from some 70 cities and states was analyzed in reference to "crime" laboratories.[1] Several indices of utilization were constructed: percentage of all known offenses processed, expenditures in city and in metropolitan areas, expenditure per processed case, percent of city revenue expended on a crime laboratory, and case load per professional staff member. Similar index calculations were carried out on data gathered in a 1965 survey of crime laboratories.[2] The first index, laboratory received cases relative to all reported cases, for both years was under two per cent. The remaining four indices were:

Index	1961[1]	1965[2]
Laboratory cost per 100,000 population (median value)	$3,650	$3,100
Expenditure per case (median value)	45	12
Support from city revenue (median value)	0.06%	0.06%
Caseload per professional staff member (median value)	247	300

Operational performance in 1961 gave the desirable average costs per case as $150 and the desirable average workload as 50 cases per professional staff member.[1,10,11] On the basis of these annual estimates, "the forensic science laboratory in the United States must handle five times the normal work load with but one-third the necessary funds."[1] The other cost indices are obviously related to the basic needs for personnel and facilities to perform examinations. In another study at Richmond, California and the use of physical evidence by that police department, laboratory processed offenses fell at the 2% national level[12] where the evidence collectors responded in about 15% of the reported cases.

The present state of knowledge as to the impact of the "crime" laboratory on the administration of criminal justice is less than satisfactory. Depending upon the viewpoint and orientation taken in considering the foregoing findings, arguments could be made regarding effect over a wide range of values from minimal to significant. While it can be said in a paraphrase of Meadow that the primary measure of performance of a crime laboratory covers the quality of the service provided to the various clients,[13] the users of scientific services have a variety of needs which are not all met adequately by the same product. The detective in his investigative phase does not need a report capable of withstanding a court review; the prosecutor in deciding to precede on a complaint does not need a report suggestive of possible avenues of investigation. There is an urgent need for primary measures of performance by scientific services pertaining to each and every user within the criminal justice system.

A Measurement of Documentary Retrieval

The documentary aspect of retrieval, or laboratory input, is the level which this study sought to measure. Since a relatively small proportion of offenses actually arrive at the doors of "crime" laboratories[1,14] a measure based on laboratory receipts is biased strongly by the decision criteria employed in selecting cases for "laboratory review." The use of offense reports on cases as a basis was rejected also as subject to some of the same criteria. An ideal basis would be an independent measure of all physical characteristics at a site of criminal activity. As a practical matter this ideal could be approached by placing a suitable observer at the site as close as possible to the time of first official notice of the crime. From the records of such observers in a number of cases there could be constructed a frequency profile of the potential input to a "crime" laboratory function. This profile would represent a maximum input against which actual operations and possible alternatives could be viewed.

An assumption was made that scientists with substantial backgrounds in dealing with physical objects, particularly those experienced in forensic applications, would be most likely to recognize the possible significances of relevant physical objects. These observers, with the cooperation of a law enforcement agency, could make site visits to crime scenes and record each physical object thought to contain information relative to the pattern of criminal activity.

A saturation coverage of major felonies within a given study period would provide sufficient data for a frequency profile according to types of objects.

A total recording of all physical characteristics in an area of violence would, in essence, mean an identical reproduction. Such a reproduction, even if possible, would not materially advance the study purpose. As reasonable boundaries for recording, all possible entrances, all possible exits, and all possible foci of violence were used. This set of boundaries did not exclude examining the possible routes connecting boundary areas nor observing any apparently unusual state of the general environment.

Perception within this framework while reducing somewhat the total reproduction of a site still requires a means of directing attention to significant objects. A categorizing model of six parts was taken for this purpose. The six categories were: position, transfer, impression, break and tear, dispersion, and physiochemical nature. Position included orientation of the physical object where the shape offered that possibility. Transfer referred to material originally on one object which remained on a second object after contact was broken between the two objects. Impression was the result of pressure imprint during the contact of two physical objects which might or might not involve relative movement of the two objects during the contact. Break and tear described the splitting apart of an object by forces involved in a contact. Dispersion was the result of an object breaking into parts which are then scattered by the disintegrating force. These five categories cover the production of patterns as the consequence of energy changes, and are not limited by the nature of the objects involved. The sixth category covered the inner structure and composition of an object itself. This categorizing model did not require that the observer have in mind any specific types of physical objects thereby allowing time to consider as an inclusion any material aspect in an area of violence.

The records resulted in a reasonably low scale of abstraction. Each field report consisted of free narrative[15] loosely-structured by the mentioned relevance, boundary, and category constraints. For each report an itemized list of physical objects was prepared on a McBee "Keysort" card along with follow-up data on the administrative processing of each case. Subsequent analyses of the complete field reports produced the frequencies of relevant physical objects. Service requests to laboratories during the study period provided another dimension of data relative to other major felonies committed but not covered by the field work.

Operations and Analyses

In the choice of a field area for conducting the study, several assumptions were made. First, the types and frequencies of physical objects possibly involved in violent acts would be similar throughout a metropolitan region. Secondly, the cooperation of a law enforcement agency interested in the purposes of the study and willing to adjust to the presence of observers in the daily operations would be essential. Thirdly, the attempt to cover the bulk of serious

crimes would limit the area for study to a population size commensurable with the use of six observers, i.e., an estimated field area population of 100,000. Several conferences with officials of the Berkeley Police Department culminated in an agreed upon plan of cooperation for carrying out the desired study in that city over a three month period.

The initial phase of the project involved the selection and orientation of the team of six observers. Three* of these men were in or had graduated from the criminalistic program at the University of California; two, moreover, had accumulated several years of experience working in "crime" laboratories and investigational agencies. The other three observers all had natural science backgrounds. Over several days all six observers were familiarized with the study design and intensive discussions were engaged in on the recognition of physical objects at sites of violence that could have possible evidenciary significance. Weekly conferences were maintained during the three-month study period to re-emphasize and re-examine recognition problems. The field operating procedures were outlined during the orientation sessions and the recording equipment was made available for practice in use by the observers. This equipment consisted of automatic recording level tape recorders (Sony-Matic 910) and a portable video recorder (Sony VCK-2400/CV-2200).

Photographs of the entire staff of observers were furnished to the Berkeley Police Department for posting in the squad room. Observers were introduced individually to all the men on various shifts at the regular Departmental briefing sessions and the nature of their association with the Department was explained. Practice runs to crime scenes were made by observers for a few days to check out the operating procedures. Consultations with members of the Department before and after these trial runs provided an opportunity to detect possible problems and decide on modifications.

Before observers were assigned to a specific shift, time period, or individual member of the Department, past offense records on reporting time were studied and several facts discovered that helped in an allocation of study resources. The rate of occurrence of part I and II offenses in Berkeley for 1967 ranged from 1000 to 1500 and from 2700 to 3800 respectively over the days of the week. For part I offenses Sunday was the lowest day and Monday the highest; for part II offenses, Sunday, the lowest day and Friday the highest. The types of offenses exhibited other fluctuating patterns. It was decided to treat each day as equal for coverage purposes. Data on the hours of each day when offenses were reported for 1968 was charted for burglary, robbery, assault, and rape (Figure I). On that basis, the bulk of those offenses were reported to the police during the second and third shifts of the day (8 a.m. to 12 midnight).

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* One Doctor of Criminology, one candidate for the Doctor of Criminology, one candidate for the Master of Criminology.

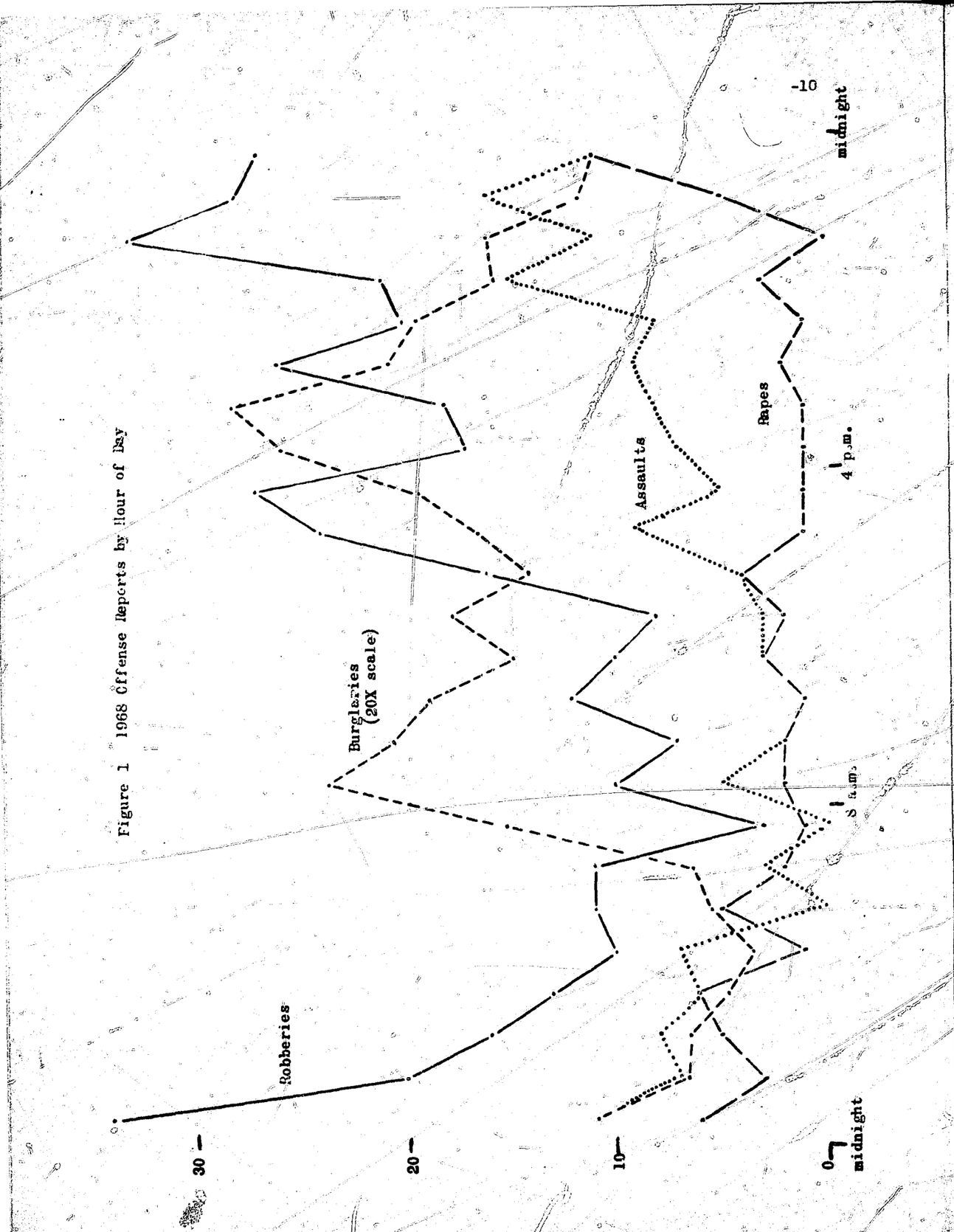

Figure 1 1968 Offense Reports by Hour of Day

From this information, the field operation was limited to a seven day a week and an 8 a.m. to 12 midnight coverage. That coverage pattern remained constant for the most part throughout the three month field observation period.

The Berkeley Police Department nominally assigns one officer to identification and evidence collection for the 8 a.m. to 4 p.m. and 4 p.m. to 12 midnight shifts. With few exceptions, this officer's primary duties were in the service division of the department and not on patrol. When serving as the I.D. man, his duties include immediate response to serious offenses in progress and to routine investigation of offense sites where physical evidence is an expected result. At crime scenes, the I.D. officer's chief function was to dust for fingerprints and take photographs of crime scenes where it was judged necessary.

Logistically the study goal was to place an observer at as many crime sites as possible during his particular shift. A variety of arrangements were tried and tested keeping this goal in mind. Most misdemeanor violations were judged not to be as potentially high in physical evidence content as most felonies. However, any situation that even seemed remotely possible of yielding information was considered to be potentially productive. Family disturbances, narcotic street arrests, shoplifting and petty theft, and miscellaneous "advice-giving" situations were, for the most part, avoided. Operating with the before mentioned I.D. officer and travelling with him to the crime scenes proved to be the best way to get at the greatest number of sites, within the shortest span of time. In order not to confine investigations solely to this method, other supplementary plans were utilized with some success.

During the evening shift, the Berkeley Department has a roving patrol sergeant who drives to offense sites where additional help is needed or an unusually serious offense has occurred. Initially, one observer was assigned to this officer and rode with him to locations and in the time span allowed made his investigation of the scene. After two weeks, it was decided that too few sites were being visited and for those that were, too little time was allowed to achieve a respectable report. An observer was also assigned to a regular patrol officer during day and evening shifts, but this too proved unsatisfactory with offense volume running at a low level.

A third method which was employed from the start of the study, involved the monitoring of the police radio communications. On occasions when an observer was inactive and a new offense was transmitted over the radio, he would go directly to that site. A portable receiving unit was kept in the staff car, and this along with the monitor in the station proved extremely helpful in getting to offenses before too much time elapsed. It should be mentioned also that for the protection of observers and the police department, a policy was adopted which required the presence of at least one officer at a site before any investigation was conducted.

Apart from infrequent scheduling difficulties, coverage lasted for sixteen hours a day, seven days a week. Because the day shift was usually busier than the evening, two observers often worked with the I.D. officer out of the service division. The number two man in this arrangement was usually free to keep track

of radio reports and to check out any reports that sounded potentially productive. In cases where the prime observer handled the video tape unit, the second observer proved very helpful during the day shift where as many as ten to fifteen cases might be handled in a single shift. The camera tended to limit the observers mobility and narrowed his investigative field. To counteract this, the audio equipped observer prepared the way for the camera and provided helpful background information and pointed out potential areas for coverage.

Throughout the study, time was a limiting factor, for the police officers were usually faced with many more cases than they could handle ideally. When the decision was made to leave a particular scene and to move onto another one, the staff observer moved also. In exceptional situations where the observer felt it necessary to stay longer, he was usually free to do so, because a separate system of transportation was maintained. Therefore, in summary, the observer, whose qualifications and instructions have been described, is placed at the site of a reported offense, by either being with an I.D. officer or by responding to a radio transmission.

The types and quantities of physical evidence present at crime scenes varied greatly from site to site. Every physical aspect of the criminal activity, which might have a possible connection to the crime, was made part of the narrative report by audio and/or video means. An example of a narration might best convey the type of report which was made by the observer. The length and depth of the report varied with the quantity of information discovered at the scene. The following example is an unusual one and was matched by cases where very little information was recorded:

> A garage owner on opening up one Monday morning immediately saw a metal box used to hold cash on the main floor and the office ransacked. His report to the police brings the identification officer to the garage. The accompanying observer would record the offense address and departmental number along with a statement as to the apparent offense. As various parts of the garage are searched by the officer, the observer is recording that the metal cash box has prymarks on the lid, that the lid was bent back, that the lock was secure and that blood is smeared on the bottom of the box and fingerprints in blood are visible. In the office, the observer notes the open cash register has dust on it which has been disturbed, the endorsed checks scattered about, the blood on some checks and a heelprint on paper near the checks. Prymarks are visible on the register but no tool is found near it or the cash box that might have been used. Some particles of glass and spots of blood are distinguishable on close examination of the floor in the office and in the garage proper. Also found on the main floor of the garage near the cash box is a pile of fecal material. A search about the garage shows a window broken inwards and a wooden stick with glass particles embedded in one end. A shoeprint is visible below the broken window in

> the greasy ground as well as a scuff mark on the wall. The paint on the walls is peeling and broken with some chips on the ground. One of the weeds growing there has been bent and projects through the broken window. A few cloth fibers are found on broken glass. There is also an area on the window frame where the paint and the rust have been disturbed. In summary, the observer records as much detail about physical conditions and materials possibly connected to the offense as he can on tape and provides a simple sketch of the place or person examined.

Each field report was considered repeatedly along with the observer's sketch of the site in itemizing every physical aspect thought likely to be involved in the criminal activity. On each McBee Keysort card representing an offense, this itemized list was placed along with a Departmental case number, the observer's name, the suspected offense classification, and, after a minimum period of two months lapse time, follow-up data on the Departmental processing of the case. Codes were constructed for these informational characteristics and each card was then punched accordingly. The suspected offense classes amounted to fifteen in number: arson, assault including battery, auto accident, auto theft, burglary including burglary of auto, drunk driving, fire bombing, hit and run, malicious mischief, murder, robbery, suicide, theft including theft from auto, fraud, and rape. Attempts were counted in the relevant suspected offense class. The follow-up data covered the administrative status of each offense: unfounded, open, closed (responsible known, responsible arrested, property recovered, other basis), latent fingerprints taken as evidence identified as responsible's or victim's, photographs taken as evidence, and physical objects taken as evidence. The physical objects itemized from the field observations were categorized case by case. Every physical object was assigned to one category; multiple entries were not counted for individual cases. Thirty-six categories resulted at first; these were narrowed to twenty-two categories plus one miscellaneous category.

Laboratory input, as determined by this study, is not hampered so much by the lack of physical evidence as it is by the lack of a systematic approach towards physical evidence. Several types of physical evidence are likely to be found in most criminal offenses, especially when the physical contact between the responsible and the crime site is protracted or vigorous. Recovery of physical evidence from crime site and from suspect is the critical entry point to use of "laboratory review." Without systematic selection, the collection of physical objects as evidence could immediately overload any manpower allocation by law enforcement agencies. The limited availability of laboratories is a second constriction on "review." An input of physical evidence used to interrelate separate offenses or to develop leads to a suspect is not utilized for the most part. An input of physical evidence used to relate an arrestee or suspect to an offense is not utilized significantly. Existing records are inadequate essentially for purposes of measuring or controlling the utilization of physical evidence in the administration of criminal justice.

The Nature of Proof by Physical Means in Criminal Matters

Human activity necessitates changes in the real world in every instance. A thought involves a change in a neuron network. A movement involves a change in the molecular states of muscle fibers. A sound involves a change in the vocal passages. A spoken word involves these changes and a change in the molecular distribution of air. These changes in matter-energy configurations and relationships constitute physical links between an activity and its human agent. If these changes can be established, they provide a basis for inferring specific human intent to engage in the particular activity as well as direct physical connections. Through documenting those changes, the sequence of events can be proven which relate a given activity to a specific actor.

The conviction of the guilty and the exoneration of the innocent in the investigation of criminal activities has occurred time and again when attention was focused on material reality as extrinsic evidence. Success in this sense of criminal investigation is amply demonstrated in the annals of detection. Such cases as Dr. Webster's murder of Mr. Parkman, the St. Valentine Day multiple murders, and the English insulin murder have shown the value of scientific examination and interpretation of the physical traces left in the wake of human violence. From the beginnings of this century in the endeavors of such men as Gross, Reiss, and Niceforo, the contributions of scientific crime detection have been considered as useful, and often essential, to many areas of criminal investigation. More recently, the task force report on the police stated that "success in complicated investigation may depend in large part upon the scientific evaluation of pertinent data" and that Supreme Court decisions suggest "the necessity of a more adequate police crime scene searching and painstaking laboratory review."[14]

The demonstration that "each criminal violation must be shown to be in fact a breaking of the law, and must be linked to a specific individual" is the functional service of "crime" laboratories.[4] Performance in fulfilling this functional responsibility on a local basis is conceded to be minimal in most law enforcement operations.[14] The need for increasing such scientific services has been expressed in a number of technological and administrative terms such as proximity of services, timeliness of services, education and training of law enforcement personnel, education and training of experts, certification of experts, research and development in techniques, standardization of methods, environmental reference standards, and local support.[14,16,17] This stress on prerequisites for increased performance assumes the performance to be vital throughout the administration of criminal justice. The record of individual successes, particularly in murder cases, is an insufficient support for this assumption. Relevance is not guaranteed by mere expansion and increased involvement.

For the "crime" laboratory, "there remains a legitimate question as to the extent of its use."[1]

Behind the operational needs there is, as stated by Dr. Blumstein, "the fundamental need to discover the impact on crime of the many actions taken to control it. Very little is known to even a rough approximation about how much any prevention, apprehension, and rehabilitation program will reduce crime. And without such knowledge, how can we intelligently choose among them?"[16] The fundamental need pertains not only to know what exists, but also to know what could exist and what should exist in the relationship of the "crime" laboratory to the administration of criminal justice. "There comes a time when an expanding scientific profession needs to stop and examine its foundations and modes of operation."[18]

The "Crime" Laboratory as a Subsystem in the Criminal Justice System

In a physical sense, the effect of a criminal upon the site of his activity, and, conversely, the effect of the site upon the criminal constitute the "pertinent" sources of information to the investigative process. This nonverbal information, however, must be retrieved before any value in the way of an interpretation can be assigned. When the interpretation is communicated to the investigative process, the value conveyed is subject to a reinterpretation by each decision maker involved. These reinterpretations are affected by the extent to which the retrieved information is part of the interpretative message and by information from other sources. The response engendered is the investigative assessment of the criminal incident. In turn, the criminal justice system generally is subject to this interplay of information, interpretation, and reaction. Problems in measuring "crime" laboratory impact occur all along the communication channels in the administration of criminal justice. This study was directed at the problem of retrieval which can be viewed in two aspects: documentary and technical.

The informational output of a "crime" laboratory, both relevant and irrelevant, depends upon the input -- the documentary retrieval. This aspect is the collecting* of physical objects from the site of the crime which might determine the event sequence for a given violation and connect the criminal to that event sequence. Figure 2 is a schematic diagram of physical retrievals from crime sites and suspects and subsequent processes.[19] The diagram shows only networks for physical objects and suspects with but two of the informational channels in that network. Operational delays in movement along the networks are included. This simple model emphasizes the critical nature of documentary retrieval as a laboratory input. Stated in Willmer's conceptual terms[20,21] the physical interaction of the site environment and the criminal during the course of a violation produces a number of constituent signals. "The total signal is made up of a

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*"Collecting" is used in the sense of physical removal and locational coordinates relative to the site.

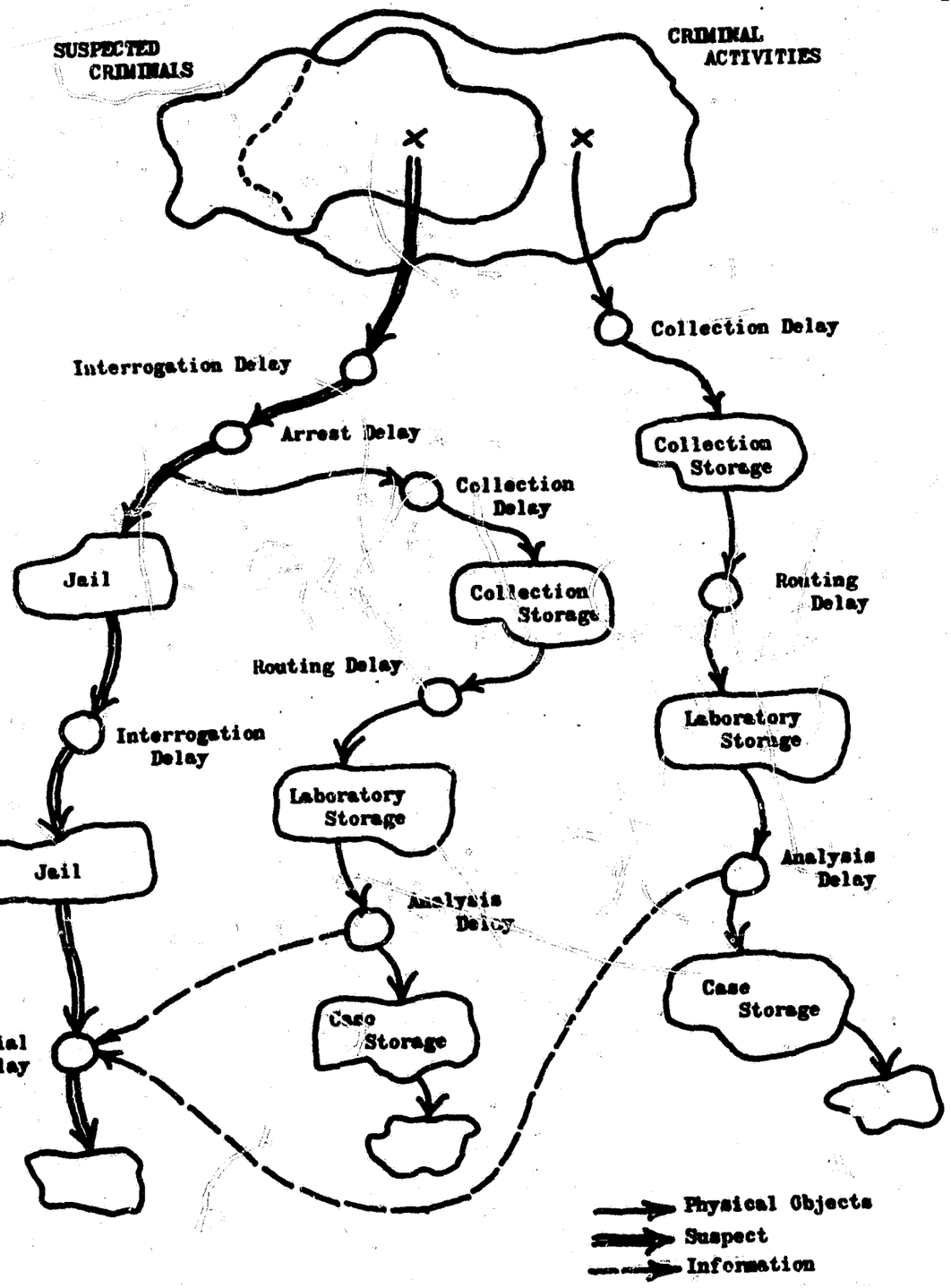

Figure 2 Pathways for Physical Evidence Retrievals

number of different messages that have different frequencies and similar interdependencies."[18] Since the choice of those physical objects bearing relevant signals from a crime site or a criminal is a unique selection, it is desirable to minimize the error of not collecting a significant object. Additionally, since the distribution at a site of physical objects bearing relevant signals is unknown, several objects collected may yield the same signal. This redundancy in collection must be tolerated. The collection, or documentary retrieval, is further complicated by "physiological shortcomings of investigators, such as vision, and psychological ones including perception."[18]

Technical retrieval of nonverbal information from a physical object is, within a laboratory operation, a selection of strategies. The choice of a strategy, or a combination of strategies, rests upon the query posed by the individual case. Within a given strategy, the search plan is a set function. For example, the finding of an unexpected stain at a crime site will raise the query as to what is it and how did it get there. In the absence of additional information as to the suspected violation, a general retrieval strategy would be necessary. This is the most difficult type of analysis to perform since the content of nonverbal information could be present in a variety of forms. During an abstraction, the recovery of one form may change or obliterate another form. The decisions on strategies to use in technical as well as documentary retrievals are extremely critical because of this potential loss in informational content. In such circumstances, the general retrieval strategy must so order the analyses that the maximum amount of nonverbal information is recovered. Where additional information is available, e.g., a suspected homocide, and identification of the stain as blood and the determination of the direction of travel by the blood drops that produced the stain are types of possible abstracted information. Two retrieval strategies, one chemical and one physical, would be used. A simple removal of the stain would preclude the physical analysis; a photograph alone of the stain would preclude the chemical analysis. Another example of a technical retrieval strategy is cyclic in nature wherein subsequent steps in the series are determined by the preceding abstractions. One such series is where a liquid is first determined to be blood; then, of human origin; then, of a particular group; then, of a particular type; and then, possibly, to fall within various classifications of additional serological factors. This aspect of technical retrieval of nonverbal information from physical objects has occupied much of the laboratory involvement in the administration of criminal justice. The allocation of resources to explore and develop this scientific examination and interpretation of nonverbal information is of basic importance. However, this necessary component of the "crime" laboratory function remains irrelevant unless physical objects are brought in for analyses.

Results

The number of cases where no physical objects could be retrieved were few in most offense classes. In the 63 suspected burglaries where this happened, five cases involved cleaned-up sites, four cases involved sites inaccessible to an

observer, and 21 cases involved situations where it was thought the entry was by key or through an unlocked door coupled with removal of a single item prominently displayed, i.e., a portable color television. For one robbery there was an inaccessible site. This data is presented in Table I with totals and adjusted totals for cleaned sites, inaccessible sites, and minimal disturbance.

Table I

Proportion of Cases with No Retrievable Physical Objects

Suspected Offense	Number of Cases	Without Objects	Adjusted*	Percentages No. Obj.	Adj.*
Burglary					
Residential	355	47	18	13	5
Non-Residential	114	7	7	6	6
Auto	78	9	8	12	10
Total	547	63	33	12	6
Auto Theft	85	5	5	6	6
Theft	45	12	12	27	27
Robbery	26	5	4	19	15
Rape	6	0	0	0	0
Assault/Battery	6	1	1	17	17
Murder	5	0	0	0	0
All Others	29	7	7	24	24
Total	749	93	62	12	8

*Totals adjusted for cleaned sites, inaccessible sites, and minimal disturbance.

Table II indicates the number of physical object categories filled for all cases in a suspected offense class with median values considering all cases and cases where physical objects were retrievable.

Table II

Physical Object Categories Per Case

Suspected Offense	Number of Cases	Number of Physical Object Categories Filled	Median for All Cases	Median for Cases with Retrievable Objects
Burglary				
Residential	355	1002	3	3
Non-Residential	114	479	4	4
Auto	78	168	2	2
Total	547	1649	3	3
Auto Theft	85	282	3	3
Theft	45	87	2	3
Robbery	26	47	1	2
Rape	6	31	4	4
Assault/Battery	6	15	3	3
Murder	5	22	6	6
All Others	29	85	2	4
Total	749	2218	3	3

The distribution about the median values for the physical object categories within given suspected offense classes can be seen in Table III.

Table III

Distributions in Physical Object Categories

Suspected Offense	Number of Physical Object Categories Filled Per Case											
	0	1	2	3	4	5	6	7	8	9	10	11
Burglary												
Residential	47	54	6[illegible]	75	48	31	12	9	2	2	6	1
Non-Residential	7	6	14	22	21	10	12	11	5	4	2	--
Auto	9	23	16	17	7	4	1	--	1	-	-	--
Auto Theft	5	10	19	12	18	9	7	3	--	2	--	--
Theft	12	7	8	11	4	3	--	--	--	--	--	--
Robbery	5	8	4	5	4	--	--	--	--	--	--	--
Rape	--	--	1	1	2	--	--	--	--	2	--	--
Assault/Battery	1	1	--	2	2	--	--	--	--	--	--	--
Murder	--	2	--	--	--	--	1	2	--	--	--	--
All Others	7	4	4	3	4	1	4	--	--	1	1	--
Total	93	115	134	148	110	58	37	25	8	11	9	1

Table IV presents the total number of offenses in each physical object category for each suspected offense class.

Table IV

Physical Object Categories Per Suspected Offense

Suspected Offense	Physical Object Category*																					Misc.	Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
Burglary																							
Residential	111	125	107	50	65	72	51	63	62	27	23	43	47	15	15	15	16	26	9	17	7	10	1002
Non-Residential	73	49	20	41	25	33	10	34	14	20	20	10	15	24	17	18	4	12	11	5	6	10	479
Auto	37	28	7	22	6	3	11	2	4	5	7	3	3	6	3	3	4	2	3	1	0	0	168
Total	221	202	134	113	96	108	72	99	80	52	50	56	65	45	35	36	24	40	23	23	13	20	1649
Auto Theft	31	36	25	12	19	8	16	3	10	23	18	1	7	7	7	8	7	3	4	2	4	2	282
Theft	18	15	6	2	4	3	3	0	3	6	4	1	1	3	4	2	4	0	3	1	1	0	87
Robbery	2	6	3	0	0	2	4	1	2	8	4	1	3	4	0	1	0	0	0	2	3	0	47
Rape	0	2	3	1	3	2	5	0	2	3	1	1	0	1	1	0	0	0	1	3	1	0	31
Assault/Battery	1	2	1	1	0	1	1	0	0	0	0	0	1	0	0	0	1	0	0	0	3	0	15
Murder	2	2	2	1	1	1	1	1	0	1	1	2	0	2	0	0	1	0	1	0	3	0	22
All Other	7	6	3	11	7	4	4	2	1	3	3	4	1	1	1	1	10	3	3	2	5	3	85
Total	282	271	177	141	130	129	106	106	98	96	88	96	81	71	65	48	47	46	35	33	33	25	2218

*An explanation of Physical Object Category on following pages.

Table IV (continued)

1. Toolmarks - This category includes all physical evidence where it was evident that one object, serving as a tool, acted on another object creating impressions, friction marks, or striations. A screwdriver, pipe, pry bar, fender of an automobile, or barrel of a gun could all produce toolmarks.

2. Fingerprints and Palmprints - All prints of this nature, latent or visible, are included. Bare foot prints, glove or other fabric prints would be included in this category also.

3. Organic, botanical, zoological material and unknown stains - Cases where matter of organic origin or stains of nonorganic nature were discovered. Excreta, all residues from trees and shrubs, and food items were typical examples.

4. Glass or plastic fragments - The presence of broken or chipped glass or plastic in an area suggesting it was the result of the responsible's actions or it might have been transferred to person(s) involved in the offense.

5. Paint - Liquid or dried paint in positions where transference would be possible to persons in that area. Freshly painted locations, cracked and peeling paint on window sills, and automobile collisions are leading examples.

6. Tracks and Impressions - Includes skid and scuff markings, shoe prints, depressions in soft vegetation or soil, and all other forms of tracking. Conventional tool marks would not be included in this category.

7. Clothing - Instances where items of clothing are left, carried, removed or discarded by persons. Individual fiber characteristics are included in a separate category.

8. Wood fragments - Cases where forces have created fragmenting or splintering in areas where transference was likely. Prying, kicking, and chopping attempts at entry points were the most frequent examples.

9. Dust - All cases where "dust" (all types of surface contamination) was noticably disturbed by someone.

10. Cigarettes, matches, related ashes - Discovery of any of these combustible items which were in such position that their relationship to responsibles was likely.

11. Paper, in various forms - There are two basic areas of identification for paper. First, where the paper itself might be traced to its original position or orientation, and second, where external information including latent prints and other contaminating substances might be present on the paper.

Table IV (continued)

12. Soil - The presence of soil or soil-like material in locations where identification or individualization seemed possible.

13. Fibers, natural or synthetic - Fibers were often found near sharp corners or edges, or on objects where electrostatic or mechanical forces caused a transfer.

14. Tools and weapons - Cases where tools and weapons were found at crime scenes or in automobiles and there was a strong likilihood that they were involved in this or another criminal offense.

15. Grease and oil - Any lubricant or fatty substance, often possessing environmental contamination, that was in a position to suggest involvement in the crime.

16. Documents - Of such quality that their origin may be traced to a person or instrument. Suicides, and robbery notes would be of this type. Also cases where instruments were stolen (check protectors) that could be traced back to a product of that particular instrument, in possession of rightful owner.

17. Containers - All bottles, boxes, cans and other containers which might hold residues or material of helpful nature.

18. Construction and packing material - All those substances commonly found in construction or packing areas, which don't belong to any of the other classifications.

19. Metal fragments - Industrial machining areas, scenes or objects of collisions, and other scrappings that would probably result in transfers to persons or objects in the vicinity.

20. Hair - Any animal or human hair discovered in an environment which could link a person with that particular area.

21. Blood - All suspected blood, liquid or dried, animal or human, present in a form to suggest a relation to the offense or persons involved.

22. Inorganic and mineralogical substances - All substances, and otherwise not belonging in another category, that could be classified under one of these headings, and bearing a relationship to the offense or offender.

Misc. Other category - Miscellaneous.

Table V

Rate of Occurrence of Physical Object Categories By Suspected Offense Class

Number of Categories Per Number of Cases in Each Category

Physical Object Category	Burglary, Residential	Non-Residential	Auto	Total	Auto Theft	Theft	Robbery	Rape	Assault/ Battery	Murder	All Others	Total
Toolmarks	.39	.68	.54	.46	.39	.24	.10	.0	.2	.4	.32	.43
Fingerprints	.41	.46	.41	.42	.45	.45	.29	.3	.4	.4	.27	.41
Organic Substance	.35	.19	.10	.28	.31	.18	.14	.5	.2	.4	.14	.27
Glass	.16	.38	.32	.23	.15	.06	.00	.2	.2	.2	.50	.21
Paint	.21	.23	.09	.20	.24	.12	.00	.5	.0	.2	.32	.20
Track	.23	.31	.04	.22	.10	.09	.10	.3	.2	.2	.18	.20
Clothing	.17	.09	.16	.15	.20	.09	.19	.8	.2	.2	.18	.16
Wood	.20	.32	.03	.20	.04	.00	.05	.0	.0	.2	.09	.16
Dust	.20	.13	.06	.17	.13	.09	.10	.3	.0	.0	.05	.15
Cigarette	.09	.19	.07	.11	.29	.18	.38	.5	.0	.2	.14	.15
Paper	.07	.19	.10	.10	.31	.12	.19	.2	.0	.0	.18	.13
Soil	.14	.09	.04	.12	.23	.03	.05	.2	.2	.4	.05	.12
Fibers	.15	.14	.04	.13	.01	.03	.14	.0	.0	.0	.05	.11
Tools	.05	.22	.09	.09	.09	.09	.19	.2	.4	.4	.05	.10
Grease	.05	.16	.04	.07	.09	.12	.00	.2	.0	.0	.05	.07
Document	.05	.16	.03	.07	.10	.06	.05	.0	.0	.0	.05	.07
Container	.05	.04	.06	.05	.09	.12	.00	.0	.2	.2	.41	.07
Construction Material	.08	.11	.03	.08	.04	.00	.00	.0	.0	.0	.14	.07
Metal	.03	.10	.04	.05	.05	.09	.00	.2	.0	.2	.14	.05
Hair	.06	.05	.01	.05	.03	.03	.10	.5	.0	.0	.09	.05
Blood	.02	.06	.00	.03	.05	.03	.14	.2	.6	.6	.23	.05
Inorganic Substance	.03	.09	.00	.04	.03	.00	.00	.0	.0	.0	.14	.04
Miscellaneous	.09	.07	.12	.09	.14	.09	.05	.2	.2	.2	.09	.10

Comparisons of field observation data with certain follow-up data on those suspected offenses are made in Table VI along with known offenses as tabulated by the Berkeley Police Department.

Table VI

Comparison of Field Observation Data with Departmental Data

Offense Class	Suspected Offense, Field Observed			Offenses Tabulated		
	Number	Involving Arrests	Known Suspect	Number	Cleared	Percent Cleared
Burglary	538*	78	61	875	260	30
Auto Theft	81*	15	3	328	83	25
Theft over $50	44*	7	3	1679 209	332 36	20 17
Robbery	26	10	3	101	51	50
Rape	6	1	0	26	17	65
Assault (Battery)	6	1	1	292(60)	244	83
Murder	5	2	1	2	2	100
Subtotal	706	111	74	3303	989	30
All Others**	28*	5	11	4900	4081	83
Total	734*	119	83	8203	5070	62

*In 9 cases no follow-up was possible and in 6 no follow-up information was available.

**Part II Crime Classes (Miscellaneous Offenses)

Table VII illustrates the offenses as officially reported, field observed and presented for laboratory review.

Table VII

Laboratory Input During Study Period

Offense Class	Official Tabulation	Field Observed Suspected	Received by Laboratory
Burglary	875	538	0
Auto Theft	328	81	0
Theft	1679	44	0
Robbery	101	26	1
Rape	26	6	0
Assault/Battery	292	6	1
Murder	2	5	2
Subtotal	3303	706	4
All Others*	4900	28	485
Total	8203	734	489

*All Others

Forgery/ Counterfeiting	165	0	6
Narcotic Drug	532	0	452
Drunk Driving	35	1	25
Remainder	3413	27	2
Total	4900	28	485

Table VIII

Distributions in Physical Object Categories for Arrest Cases

Suspected Offense	Number of Cases Involving Arrests	Number of Physical Object Categories Filled Per Case												Total Cases With Objects
		0	1	2	3	4	5	6	7	8	9	10	11	12	
Burglary															
Residential	54	6	5	10	14	7	5	4	1	0	0	2	0	0	48
Non-Residential	13	2	2	0	2	2	2	0	1	0	1	1	0	0	11
Auto	11	2	4	2	3	0	0	0	0	0	0	0	0	0	9
Auto Theft	15	1	1	1	3	6	0	0	0	0	1	0	0	0	14
Theft	7	2	0	2	2	1	0	0	0	0	0	0	0	0	5
Robbery	10	0	4	1	3	1	1	0	0	0	0	0	0	0	10
Rape	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Assault/Battery	1	0	0	0	1	0	0	0	1	0	0	0	0	0	1
Murder	2	0	1	0	0	0	0	2	0	0	1	0	0	0	2
All Others	5	0	1	0	1	0	0	0	0	0	0	0	0	0	1
Total	119	13	17	17	28	19	8	7	4	0	3	3	0	0	106

Table IX

Physical Object Categories Per Arrest

Suspected Offense	No. of Cases Involving Arrests	Physical Object Category																						Total	Total Cases With Objects
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Misc.	
Burglary																									
Res.	54	15	61	18	12	11	7	9	11	9	3	4	6	9	3	1	2	4	4	0	3	3	2	3	200	48
Non-Res.	13	7	11	4	4	2	1	1	4	0	2	4	1	1	2	3	2	0	1	0	1	1	1	2	55	11
Auto	11	2	11	0	0	1	1	2	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	1	21	9
Auto Theft	15	6	9	5	3	3	2	3	1	2	4	3	3	1	2	0	2	1	0	2	0	2	0	2	56	14
Theft	7	2	3	1	0	0	0	1	0	0	2	1	0	1	0	0	1	0	0	0	1	0	0	2	15	5
Robbery	10	1	3	1	0	0	1	2	0	1	3	2	1	2	3	0	1	0	0	0	2	2	0	0	25	10
Rape	1	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	4	1
Assault/ Battery	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	1
Murder	2	1	2	1	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	9	2
All Others	5	1	2	0	0	4	4	1	1	1	1	1	1	0	0	1	0	0	0	1	2	2	1	0	24	5
Total	119	35	104	31	20	21	17	21	17	13	17	15	12	14	12	5	8	5	5	4	10	12	4	10	412	106

Among the field observations, those cases where a suspect was connected to the crime scene through a latent fingerprint numbered 17 out of the 119. This type of identification was made in 8 residential burglaries, 3 auto burglaries, 3 auto thefts, 2 non-residential burglaries, and 1 hit-and-run case. The proportion of adult to juvenile suspects was 67 to 52 respectively among the 119 cases involving arrests.

In 83 cases, a suspect's identity was known although no arrest had been made. Table X presents for these 83 cases a breakdown as to the absence or presence of physical objects in the various categories.

Table X

Distributions in Physical Object Categories

for Known Suspect Cases

Suspected Offense	Number of Cases	Number of Physical Object Categories Filled Per Case												Total Cases With Object
		0	1	2	3	4	5	6	7	8	9	10	11	12	
Burglary															
Residential	38	2	12	3	7	7	3	1	2	1	0	0	0	0	36
Non-Residential	14	0	1	1	1	4	1	4	0	1	0	1	0	0	14
Auto	9	1	1	2	4	1	0	0	0	0	0	0	0	0	8
Auto Theft	3	1	0	0	0	0	1	0	1	0	0	0	0	0	2
Theft	3	1	1	1	0	0	0	0	0	0	0	0	0	0	2
Robbery	3	0	2	1	0	0	0	0	0	0	0	0	0	0	3
Rape	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Assault/Battery	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Murder	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1
All Others	11	4	1	2	1	2	0	0	0	0	0	1	0	0	7
Total	83	9	20	10	13	14	5	5	3	2	0	2	0	0	74

Table XI

Physical Object Categories Per Known Suspect Case

Suspected Offense	No. of Cases	Physical Object Category																							Total	Total Cases With Objects
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Misc.		
Burglary																										
Res.	38	14	20	7	3	7	3	3	11	10	4	3	2	7	3	2	2	2	3	1	2	2	1	2	114	36
Non-Res.	14	11	9	3	4	4	6	0	7	1	3	3	2	1	6	3	2	1	0	3	1	0	0	1	71	14
Auto	9	7	3	0	4	1	0	1	0	0	1	2	1	1	0	0	0	2	0	0	0	0	0	0	23	8
Auto Theft	3	1	1	2	0	1	0	0	0	0	1	1	1	0	1	1	0	0	0	0	1	0	0	1	12	2
Theft	3	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2
Robbery	3	0	2	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	5	3
Rape	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Assault/Battery	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1
Murder	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
All Others	11	2	3	2	1	0	0	2	1	0	1	1	0	0	1	0	1	4	0	1	0	3	2	1	26	7
Total	83	36	39	14	13	13	9	6	19	11	12	11	6	9	12	6	5	9	3	5	4	5	3	6	256	74

Discussion

In the structure of the criminal justice system, the impact of scientific services could affect a number of decision points. At the beginning, a citizen's decision to notify his law enforcement agency of inflicted injury or damage can be influenced by that citizen's knowledge or misknowledge about scientific crime detection. The patrol response to that report and subsequent evaluation will decide the possible engagement of the services by a "crime" laboratory. Where the patrol evaluation, in effect, refers the matter to the detective division, the question will again arise. If the assessment is to seek scientific involvement, the choice of physical objects to be collected may be made by the patrol officer, the detective, a specialized evidence technician, or laboratory personnel. On the arrest of a suspect, discretion must be exercised to collect physical objects from, or in the possession of, that individual. The laboratory operation excerpts the nonverbal information and offers an evaluation of its meaning with respect to the specific case. The law enforcement agency's decision to release or to seek a complaint can be influenced by the laboratory's evaluation. The office of the prosecutor in reviewing the case for a dismissal or a prosecution action is affected by the laboratory report. A defense response must weigh the scientific evidence against or for the defendant. If a pre-trial conference takes place, scientific evaluation can qualify the route of pleading. During a trial, laboratory findings and interpretations can convince a judge or jury on the issue of guilt or innocence. In appeal, the presence or absence of a scientific report may well relate to the questions of due process and other constitutional issues.

The impact of forensic science has been traditionally one of individual outstanding cases rather than significant quantities of cases where analysis of physical evidence has contributed to the administering of justice. For this study the major purpose was to examine the potential input into a laboratory by actually going to the crime sites and measuring the available material. The task was to examine the day after day case load in a community to establish if criminalistics could become more of a working aid, rather than a last resort where all else has failed. That decision point where private knowledge becomes public notice in the structure of the criminal justice system was the focus for learning if broad patterns of physical evidence existed that could be helpful in apprehension.

The fact that only 12% of all the burglaries investigated had no potential physical evidence was quite impressive.* Burglaries are often an offense class where few service requests are made of a laboratory, i.e., about 5% or less of known offenses.[23,24]

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*Burglary in California does not require forcible entry.

It should also be considered that the reports were limited to 10-15 minutes for the average investigation. Those crime categories which often do not involve a physical interaction between the responsible and the victim or his property (petty thefts, robbery) proved to be the largest categories where no physical evidence was reported. The inaccessibility of certain crime sites prevented adequate investigation, therefore adding to the cases where nothing was retrieved.

It is also significant that for all cases, physical objects was not usually confined to one particular type. The median number of physical object categories for burglary was, 3; for robbery, 1; and for murder, 6. That is, evidence is not only present, it is present in usually more than one form. This might prove to be a strategic aid, for if there were a tendency for officers or investigators to terminate their search after one type of evidence was recovered, these figures indicate they should not do so. Operationally, it might be impossible to recover and evaluate each form, therefore, it seems even more important to identify the types, so that priorities may be established. Because burglaries proved to be such a large category, it was broken down into subtypes, selected as residential, non-residential, and auto.

Non-residential burglaries seemed to yield consistently more physical objects than residential or auto burglaries. This can probably be explained by the security precautions of non-residential structures, their overall size, and the inside conditions. That is, quantity of evidence types apparently depend more on the structure and its contents than the persons committing the offense. More non-residential buildings required an actual "breaking and entering" while homes and autos, even if they were locked, did not prove to be as secure. The larger the burglary site, the more surface area the burglar usually covered. In a restricted environment like a car there was less for the person to disturb. Residences were usually cleaner and freer from quantities of dirt, grease, and machine waste material.

With the unadjusted proportions represented in Table I, physical objects from 7 out of every 8 criminal activities would appear as a likely laboratory input. An adjustment for cleaned or inaccessible areas increases the potential input to objects from 9 out of every 10 criminal activities. While subject to constraints resulting in smaller proportional input, as a practical matter this boundary is important to remember since it supports the contention that few criminal activities leave no physical record and implies a necessity for comprehensive documentary retrievals.

Among the constraints diminishing the potential input to a laboratory are those which estimate the extent of damage as minimal and those which construe the activity as minor. Examples would be theft under $50 and disorderly conduct respectively. A third constraint reducing the input would be transitory changes unlikely to leave a substantial record, e.g., a verbal assault. On applying these constraints along with the unadjusted proportional results from the field observations to the total offenses tabulated for the study period, the approximate laboratory input drops to physical objects from 1 out of every 4 criminal activities. This outcome is presented in Table XII. Within the first seven

offense classes the approximate input proportion is 2 out of every 5 criminal activities (1397 in 3303); for all other offense classes the forgeries, narcotic drug violations and drunk driving represent an approximate input of 1 out of every 7 criminal activities (732 in 4900). The 1 in 4 ratio would have produced a laboratory input of 2129 cases in the three-month study period.

Physical objects are not equal in probative value and this fact places another limit on "laboratory review." Since the evidential worth is correlated closely to a specific case circumstance, this limit would be assessed better in a pilot operation of a "crime" laboratory. However, with physical objects from three categories occurring in half the offenses observed (Table II), this limit is thought to be small for two reasons. First, the technical retrieval of information will be necessary in many instances to know what is knowable. Secondly, the physical objects observed include a substantial number of items with high probative value. In this latter connection it is worth noting that the two categories of toolmarks and fingerprints account for one-quarter of all category entries (Table IV).

The use of scientific review as exemplified by the 489 cases received by laboratories (Table VII) from the 8203 reported cases in Berkeley appears very limited. A current crisis in narcotic drug violations accounts for 452 of the 489 cases. Only 4 cases in the remaining 37 cases arrive at a laboratory from among the first 7 offense classes. Since the full resources of a laboratory could be engaged in correlating documentary retrievals from both crime site and suspect, the field data is restructured for the first seven offense classes (Table XIII, infra p. 40).

Table XII

Approximate Laboratory Inputs, 3 Months

Total Offenses		Offenses with Retrievable Physical Objects	Offenses Classed as Major
Burglary	875	775	775
Auto Theft	328	309	309
Theft	1679	1230	---
over $50	209	153	153
Robbery	101	82	82
Rape	26	26	26
Assault/	292	243	--
Battery	60	50	50
Murder	2	2	2
Subtotal	3303	2667	1397
Forgery	165	165	165
Narcotic Drug	532	532	532
Drunk Driving	35	35	35
All Others	3413	---	---
Subtotal	4900	732	732
Total	8203	3399	2129

Table XIII

Laboratory Inputs From Field Observed Offenses*

Suspected Offense	Possible Input	Arrests	Potential Input Known Suspects	Total	Actual Input
Burglary	484	68	58	126	0
Auto Theft	80	14	2	16	0
Theft	33	5	2	7	0
Robbery	21	10	3	13	1
Rape	6	1	0	1	0
Assault/Battery	5	1	1	2	1
Murder	5	2	1	3	2
Total	656**			168	4

*The figures for suspected offenses, arrests, and known suspects are based on the field observations where physical objects were noted in individual cases. The actual input figures are based on all tabulated offenses for the study period.

**749 cases minus 93 cases, Table I.

An extrapolation of the data in Table XIII to the total offenses* in the three-month study period (Table VI) would show a possible input of 1190 cases and a potential input of 305 cases compared to the actual input of 4 cases to a laboratory operation. Adding the cases from forgeries, narcotic drug, and drunk driving cases would give possible and potential inputs of 1922 and 1037 respectively.

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*Thefts under $50 and assaults other than batteries were excluded in this extrapolation.

The 489 cases received by laboratories from among 8203 reported cases in Berkeley is of the order of magnitude previously noted,[1] around 2% nationally in 1961. A question asking how many cases were referred to laboratories by police departments in 1968 was sent to cities in the population bracket of 50,000 to 250,000. Replies from 316 cities included 56 which answered that question. Of the 39 responding cities with populations from 50,000 to 99,000 the median submission rate per year was 414 cases per 100,000 population; the 17 responding cities with populations from 100,000 to 250,000 reported a median submission rate per year of 428 cases per 100,000 population. For all 56 cities replying to that question, the median submission rate per year was between 428 and 455 cases per 100,000 population. The Berkeley data extrapolated to a year basis would give a submission rate of 990 cases per 100,000 population. This crude measure suggests the general use of scientific review in the administration of justice is on a level similar to that of the Berkeley Police Department.* Moreover, since each case submitted involves an allocation of resources, primarily man-hours, the administrative processing is an important constraint on "laboratory review." In this light, the submission rate and the related proportion of cases may be determined largely according to resource allocation as influenced by prevailing policies on what constitutes serious enough crime, i.e., currently the problem of drug abuse.

Webster's study[25] on the patrol duty time accorded to evidence collecting indicated a 3.3% allocation. The results of a recent study in New York for three counties demonstrated a request for "laboratory review" in 3.8% of reported cases (1102 out of 28,795).[23] This places the actual laboratory input from Berkeley, 6.0% (489 out of 8203), in a different perspective. In drawing together the various estimates based on the field study, the contrast of the actual laboratory input, 489 cases, to these amplifies the difficulties of various administrative responsibilities (Table XIV). If leads to suspects are desired from physical evidence, i.e., active information in Willmer's terminology,[26] then an input four times greater than actual would be required (2129 relative to 489). An affirmation or negation of a suspect's involvement as the yield from physical evidence, i.e., passive information in Willmer's terminology,[26] would require over a two-fold increase in the actual input (1037 relative to 489). Physical evidence to be used as passive information would require documentary retrieval in as many cases as where physical evidence was used as active information (2129 relative to 489) since the discovery of a suspect in a given case is unpredictable.[27] The interrelating of separate offenses by the use of physical evidence also would require documentary retrieval in more cases for certain classes of offenses, e.g., burglaries involving toolmarks.

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*For other comparisons between Berkeley Police Department and other departments, see graphs 3 to 10 in appendix.

Table XIV

Levels of Laboratory Input -- 3 Month Period

Number of Cases	Administrative Responsibility
8203	Total cases to be investigated (Table VI)
7220	Laboratory review of every case with retrievable physical objects (Tables I and VI)
2129	Laboratory review of major cases with retrievable physical objects (Table XII)
1922	Laboratory review of field observed cases (major cases with retrievable physical objects plus cases of forgery, narcotic drug violations, and drunk driving) (explanation of Table XIII)
1037	Laboratory review of field observed cases where an arrest was made or a suspect known (explanation of Table XIII)
489	Actual laboratory review of cases (Table VII)

The conclusions reached in this study on input for "laboratory review" are that,

(1) most offenses will have some type of physical evidence, particularly with intensive or extensive physical contact between the responsible and the crime site (Table II),

(2) the variety in types of physical evidence suggests systematic samplings of a crime site and a suspect are essential (Table IV),

(3) record systems are largely inadequate for the purpose of measuring input,

(4) potential input based on arrests and/or known suspects is largely unrealized (Table XIII),

(5) possible input, where leads to a suspect might be developed or the interrelationship of separate offenses might be established, is even less utilized (Table XIII), and

(6) system limitations, i.e., resources for documentary and technical retrieval, appear to be major factors in the low utilization of scientific knowledge in the administration of criminal justice.

BIBLIOGRAPHY

1. Parker, B.P. "The Status of Forensic Science in the Administration of Criminal Justice," Rev. Jur. U.P.R. 32 (1963) p. 405.
2. U.S. Dept. of Justice. Crime Laboratories -- Three Study Reports (1968)
3. Lassers, W.J. "Proof of Guilt in Capital Cases -- An Unscience," J. Crim. Law, Crim. and Pol. Sci. 58 (1967) p. 310.
4. Parker, B.P. "Science and Crime," Tech. Rev. 70 (M.I.T.) (1968) p. 10.
5. Lassers, Willard J. "Proof of Guilt in Capital Cases -- An Unscience," J. Crim. Law, Crim. and Pol Sci. 58 (1967) p. 310.
6. A. dis Grazia (pen name). "Suicide?....the Investigation of Suicides and Attempts in a City of Over 400,000 Population," Graduate Seminar Paper (unpublished), School of Criminology, U.C. Berkeley (1967).
7. Misner, G.E. "Prevention and Deterrence of Robbery and Assaults on Bus Drivers," Draft, School of Criminology, U.C. Berkeley (1967).
8. Natoli, Richard, Peterson, Joseph, and Ward, Richard. "An Evaluation of Physical Evidence Collection in the Richmond, California, Police Department," Graduate Seminar Paper, (unpublished), School of Criminology, U.C. Berkeley (1969).
9. Zuniga, Barbara. "Scientific Evidence and Juvenile Offenses -- An Analysis," Graduate Seminar Paper, (unpublished), School of Criminology, U.C. Berkeley (1969).
10. Smith, H. Ward. "Forensic Science in Canada," in Law, Medicine, Science -- and Justice (Bear, L.A., ed., Parker, B.P., assoc. ed.) (1964) p. 448.
11. 1961 Annual Report Att'y Gen. Lab., Province of Ontario, p. 76.
12. Parker, B.P. "Scientific Laboratory Services for the Richmond Police Department," Report to Research and Development Unit, Richmond, California, Police Department (1968).
13. Meadow, Charles T. The Analysis of Information Systems (1967) p. 129.
14. President's Commission on Law Enforcement and of Justice. Task Force Report: The Police (1967) pp. 51,90.

15. Bross, I.D.J. "Feasibility of Automated Information Systems in the Users' Natural Language," American Scientist 57 (1969) p. 193.

16. Subcommittee on Science, Research, and Development, Committee on Science and Astronautics, U.S. House of Representatives, 90th Congress, 2nd Session, Utilization of Federal Laboratories (1968) pp. 289,335.

17. Wilkins, L.T. "Priorities," Discussion Paper, National Council on Crime and Delinquency (1968) p. 34.

18. Peterson, J. "Forensic Science and Information Theory," Graduate Seminar Paper (unpublished), School of Criminology, U.C. Berkeley (1969).

19. Forrester, J.W. Industrial Dynamics (1961) p. 139.

20. Willmer, M.A.P. "The Criminals as a Transmitter of Signals," Home Office (England) SA/PM (1966) p. 12.

21. Willmer, M.A.P. "On the Measurement of Information in the Field of Criminal Detection," Operational Research Quarterly 17 (1968) p. 335.

22. Benson, W.R., Stacy, Jr., J.E., Nicol, J.D. "System Analysis and the Crime Laboratory," Paper presented at Third National Symposium on Law Enforcement Science and Technology, Chicago, 1970.

23. Rosenthal, P. Planning Study for Evaluation of Forensic Laboratory Services in Erie, Niagara, and Wyoming Counties, New York (1969) p. 50.

24. Smith, H.W. "Forensic Science in Canada," in Law, Medicine, Science -- And Justice (Bear, L.A., ed.) (1964) p. 448,458.

25. Webster, J.A. "Police Task and Time Study," D.Crim. Thesis, School of Criminology, U.C. Berkeley (1968) p. 211.

26. Willmer, M.A.P. "Criminal Investigation from the Small Town to the Large Urban Conurbation," British Journal of Criminology 8 (1968) pp. 259,261.

27. Ostler, R.D. "Criminals Incorporated," The Police Journal 38 (1965) p. 161.

APPENDIX

Graphs 1 through 10 were constructed from data in the following sources:

United States Department of Justice, Federal Bureau of Investigation, Crime in the United States, Annual Reports 1959 to 1968,

California Department of Justice, Bureau of Criminal Statistics, Crime and Delinquency in California, Annual Reports 1959 to 1968,

City of Berkeley, Police Department, Annual Reports 1959 to 1968,

United States Bureau of the Census, Statistical Abstracts of the United States, 90th ed., 1969, pp. 21-22, and

Rand McNally and Company, Commerical Atlas and Marketing Guide, 100th ed., 1969, pp. 40-41.

These graphs are semilog (1 to 6) and log-log (7 to 10).

Additional information on Berkeley may be found in the following publications of the Berkeley Planning Department:

Berkeley Facts 1968,

Berkeley Master Plan 1968, and

Model Cities Program: Planning Grant Application 1968.

Table XV

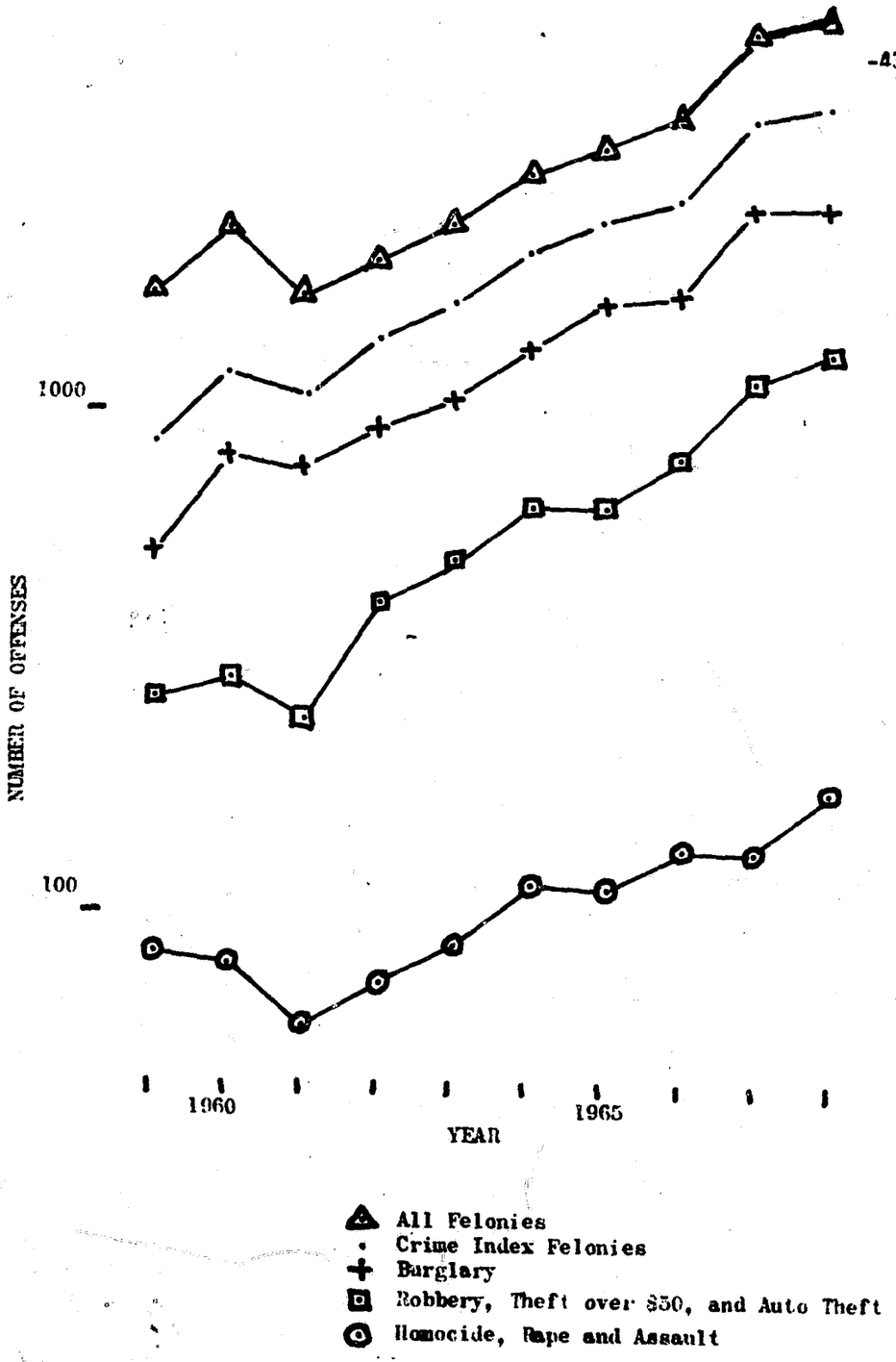
Berkeley Police Department -- Cases Reported

For July, August and September, 1969

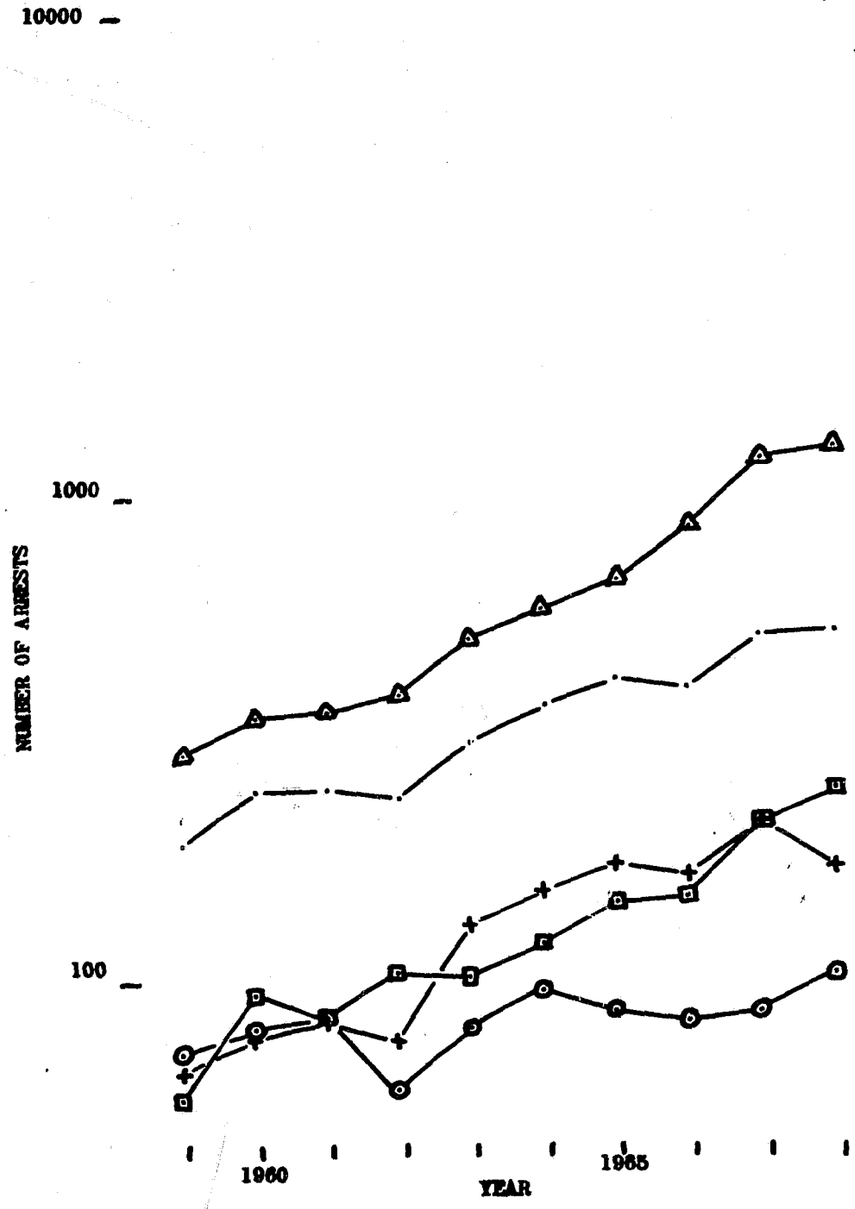
Offenses Known to Police	Reported		Counted in this Study as a Basis	
Criminal Homicide	2		2	
Rape	26		26	
Robbery	101		101	
Assault	292		292	
Burglary	875		875	
Larceny-Theft				
$50 and over	209		209	
Under $50	1470		1470	
Auto Theft	328		328	
Subtotal		3303		3303
Vandalism	525		525	
Forgery and Counterfeiting	165		165	
Embezzlement and Fraud	210		210	
Stolen Property, buying, receiving, possessing	29		29	
Weapons, carrying, possessing, etc.	126		126	
Prostitution and Commercialized Vice	1		1	
Sex Offenses	47		47	
Offenses Against Family and Children	37		37	
Narcotic Drug Laws	532		532	
Liquor Laws	74		74	
Drunkenness	124		124	
Disorderly Conduct	153		153	
Vagrancy	123		123	
Gambling	2		2	
Driving while Intoxicated	35		35	
Violation of Road and Driving Laws	4806		0*	
Traffic and Motor Vehicle Laws	6911		0*	
All Other Offenses	2998		2608**	
Suspicion	109		109	
Subtotal		17,007		4900
Total	20,310		8203	

*Offenses essentially handled by citation.

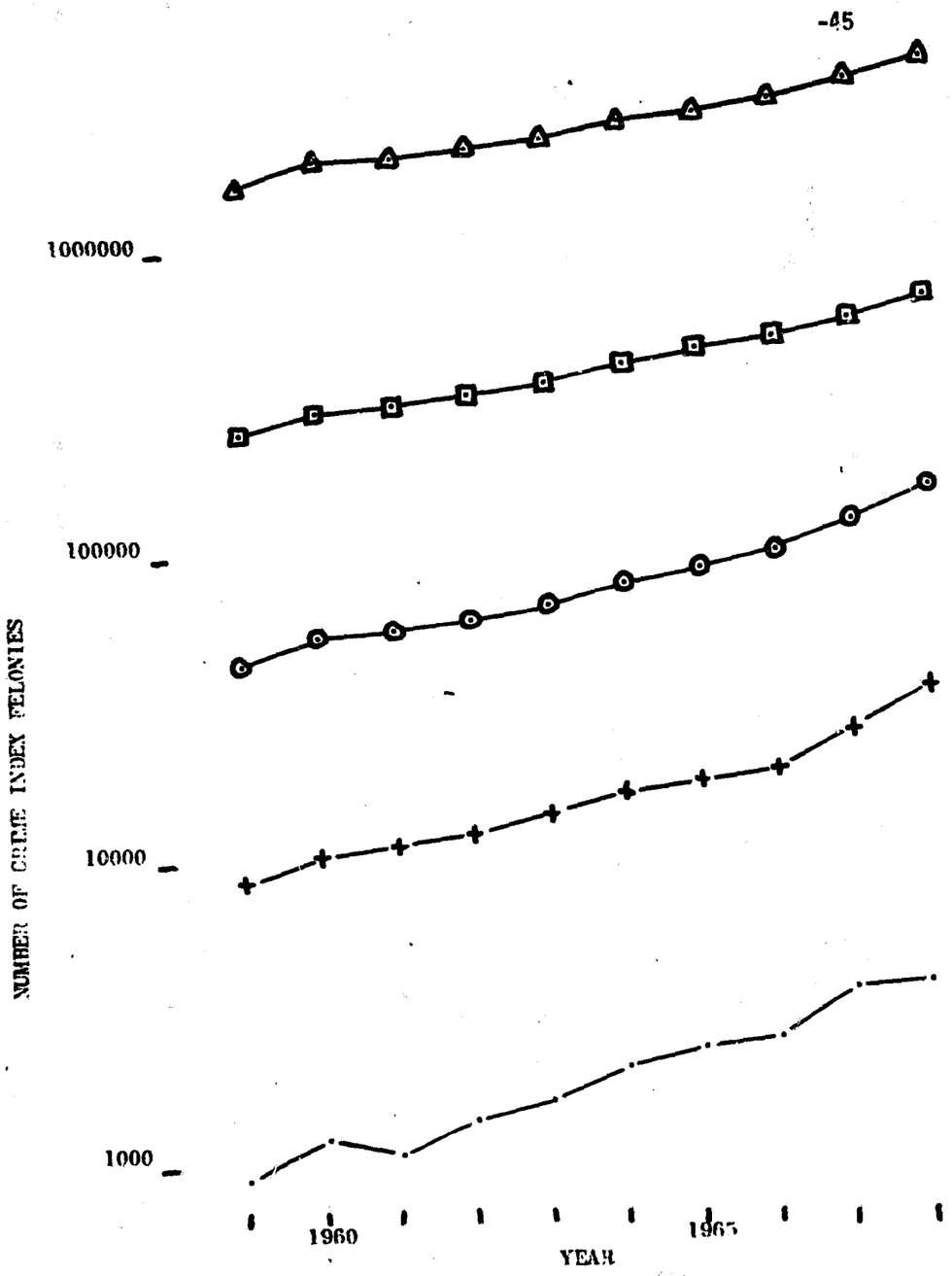
**Other offenses reduced where citations involved.



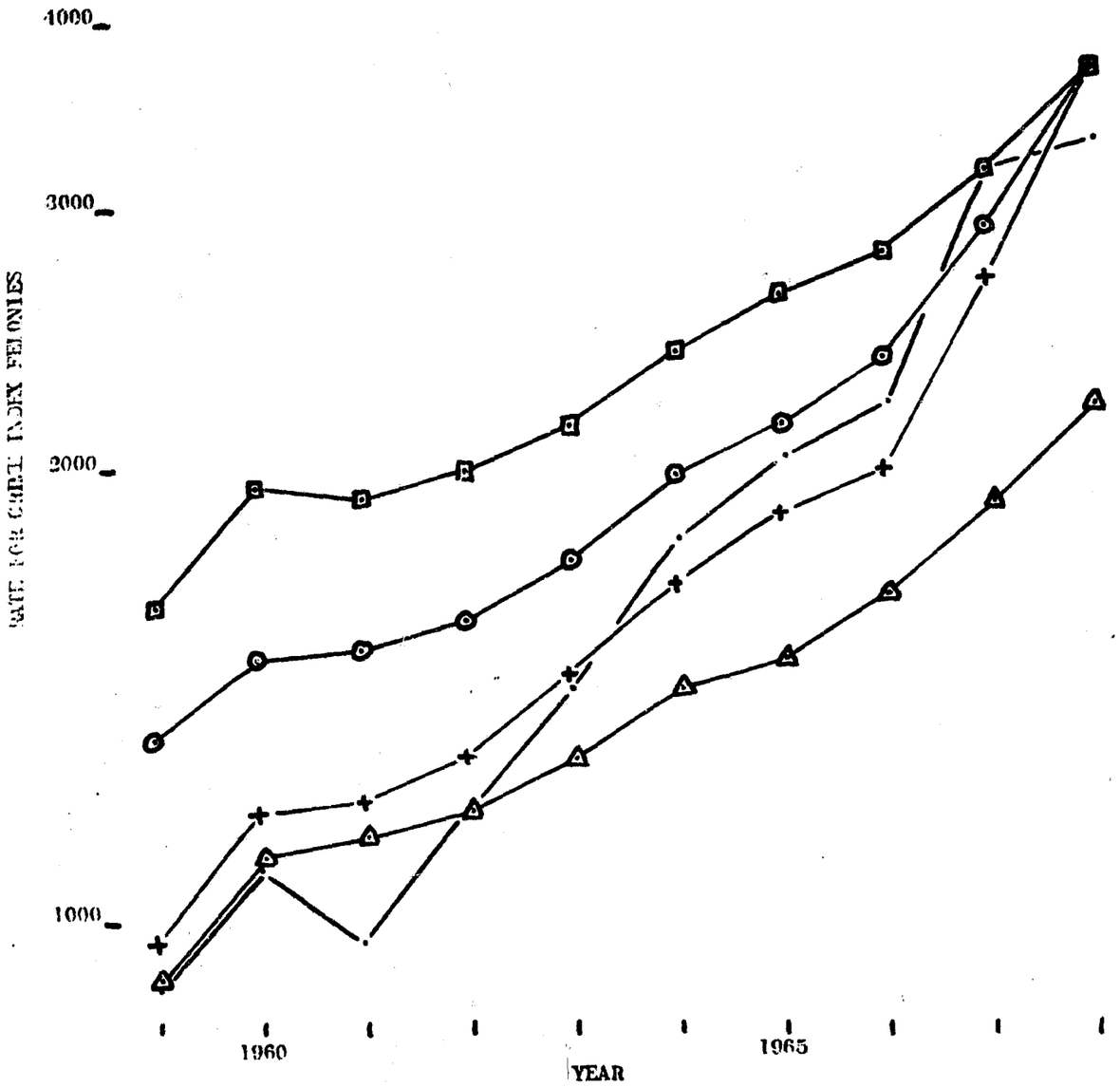
GRAPH 1 BERKELEY CRIME STATISTICS



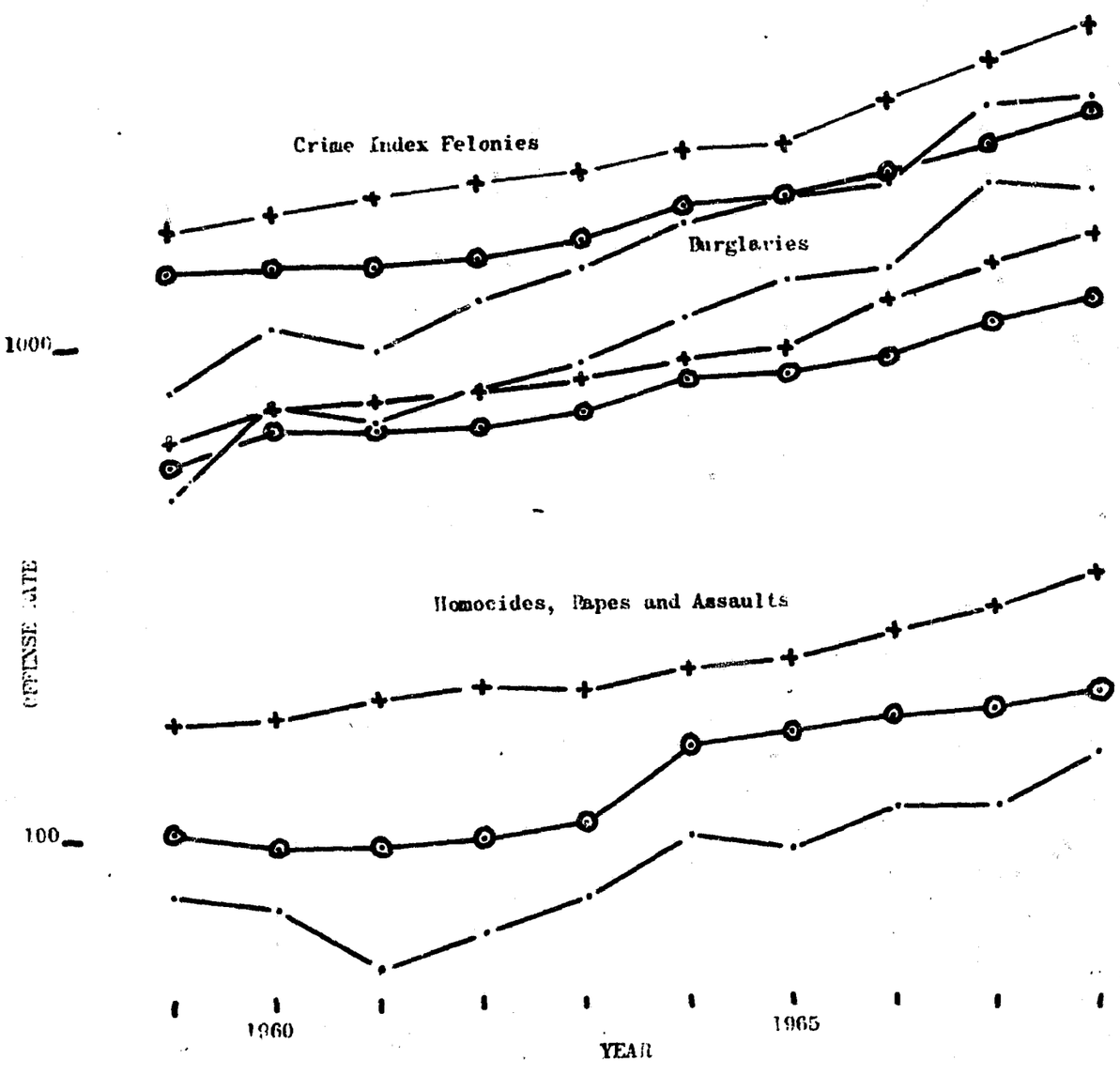
GRAPH 2 BERKELEY CRIME STATISTICS



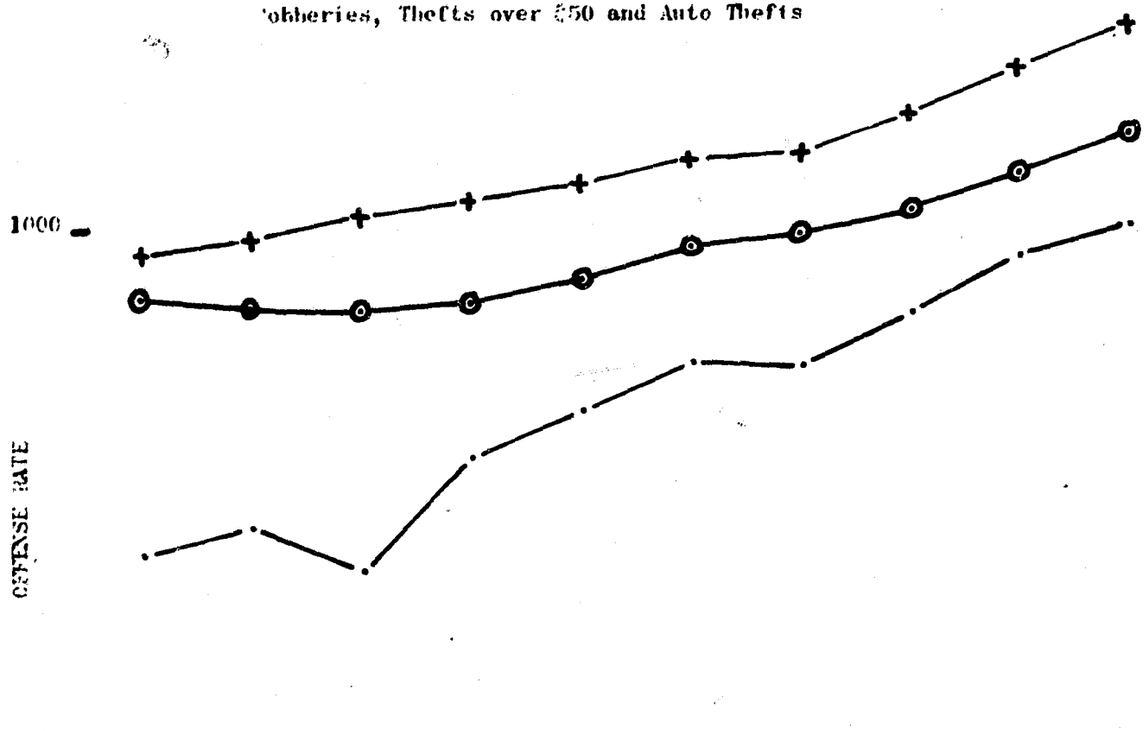
GRAPH 3 NATIONAL AND REGIONAL CRIME STATISTICS



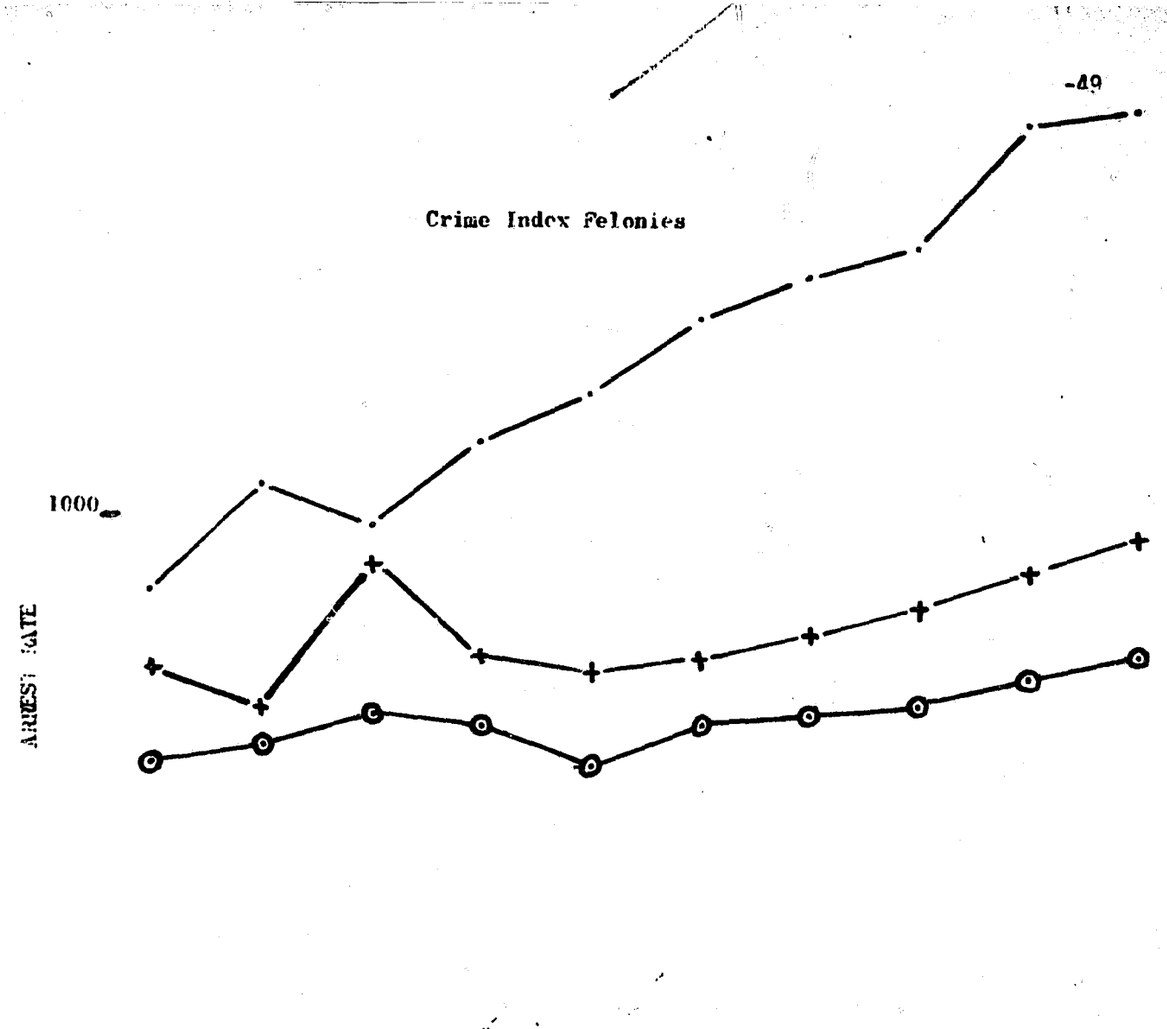
GRAPH 4 NATIONAL AND REGIONAL CRIME RATE STATISTICS



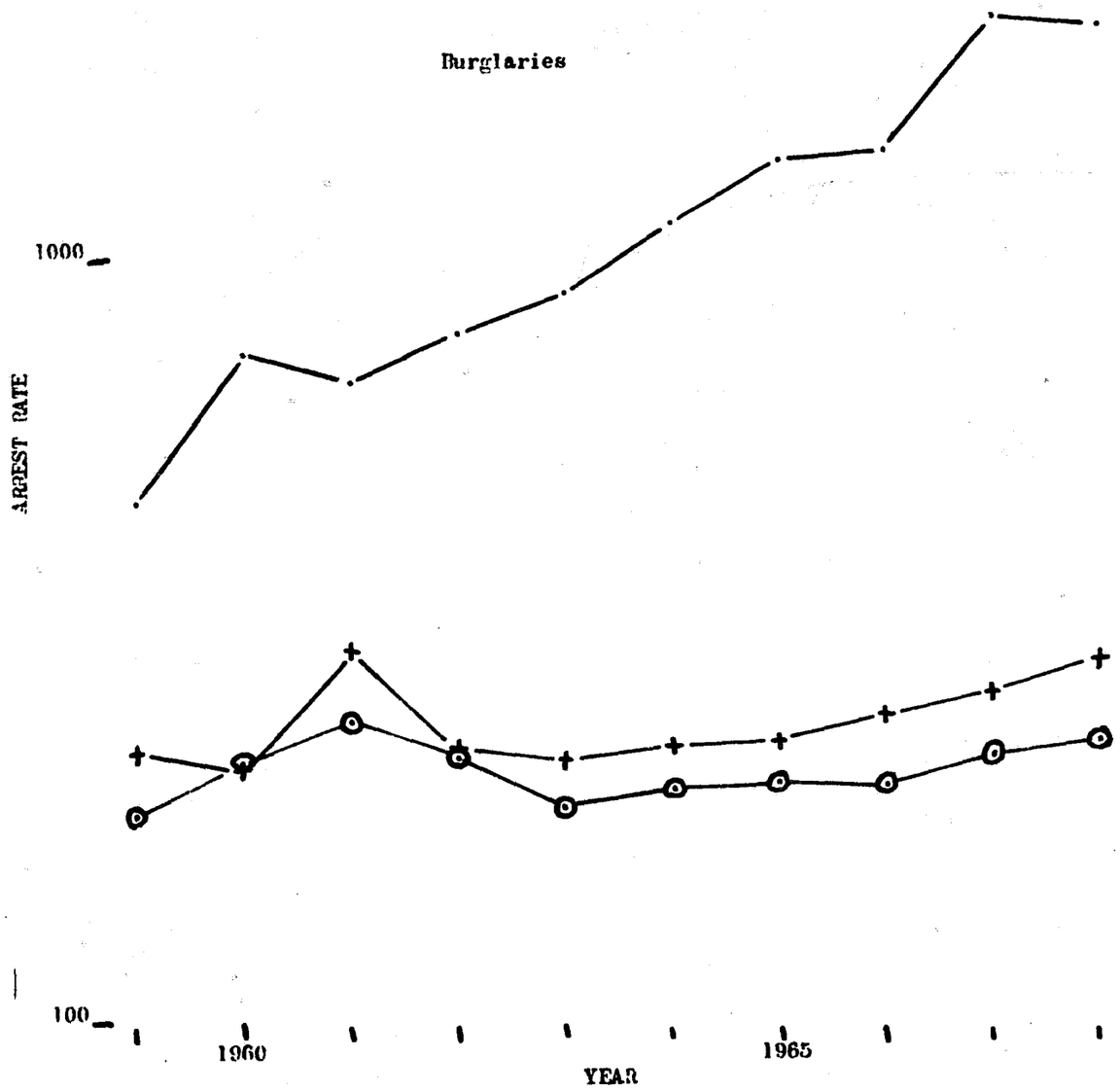
GRAPH 5a OFFENSE RATE COMPARISONS



GRAPH 5b OFFENSE RATE COMPARISONS

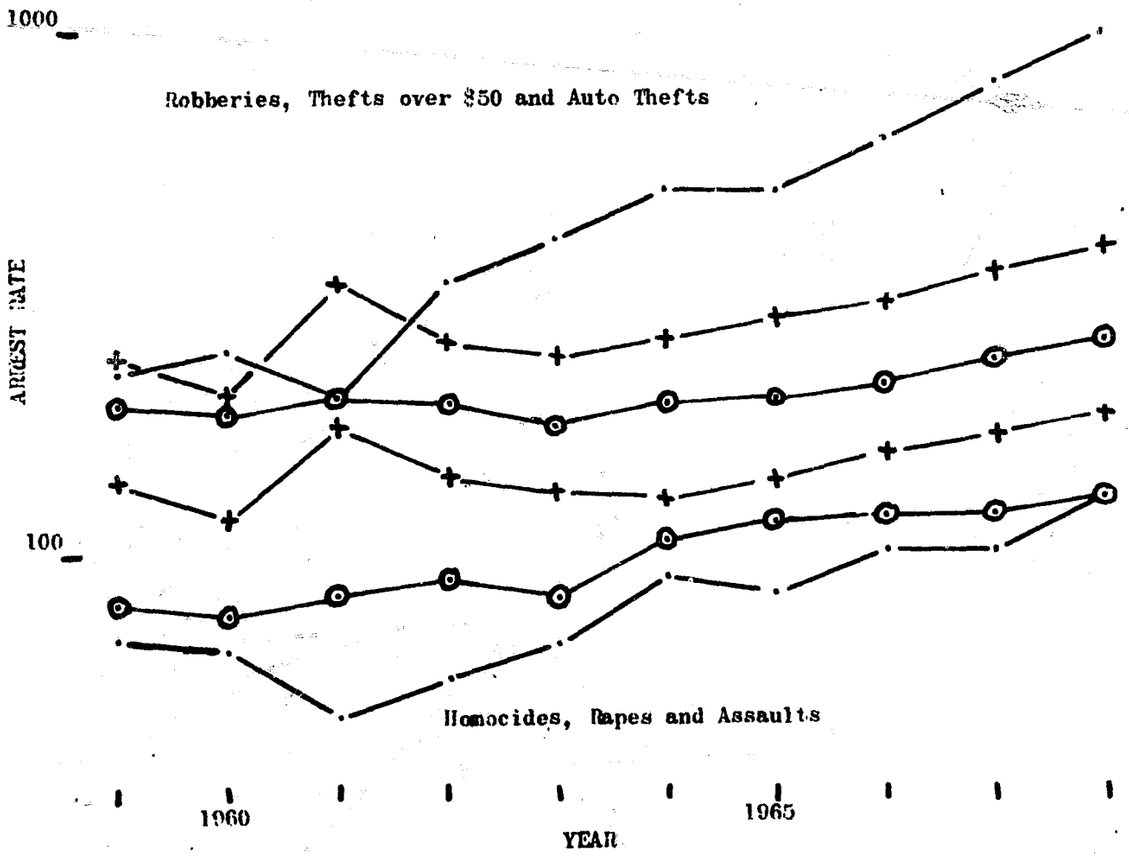


GRAPH 6a ARREST RATE COMPARISONS



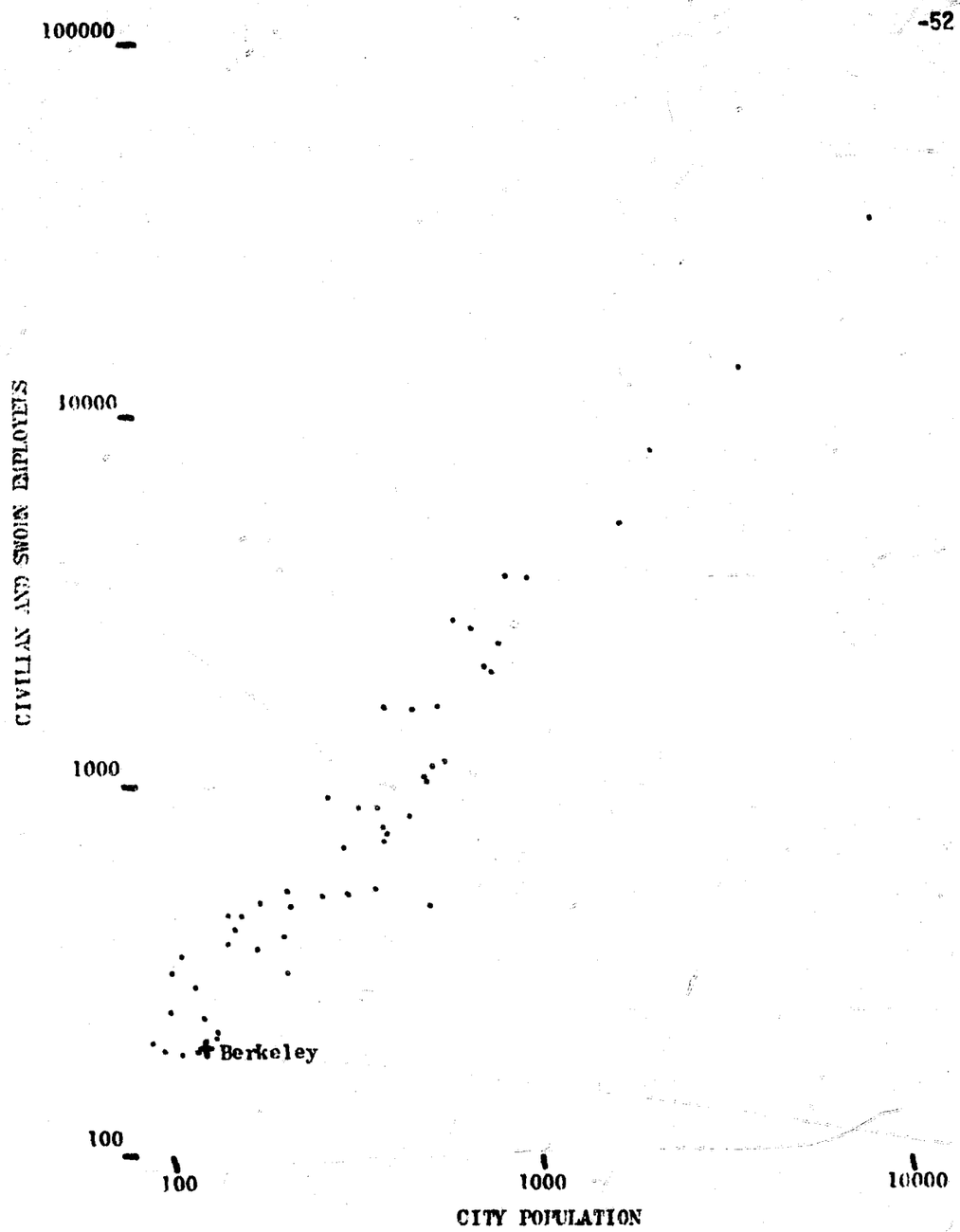
⊙ Cities with 100,000 to 250,000 population
\+ Cities over 250,000 population
• Berkeley (1968 estimated population 122,000)

GRAPH 6b ARREST RATE COMPARISONS

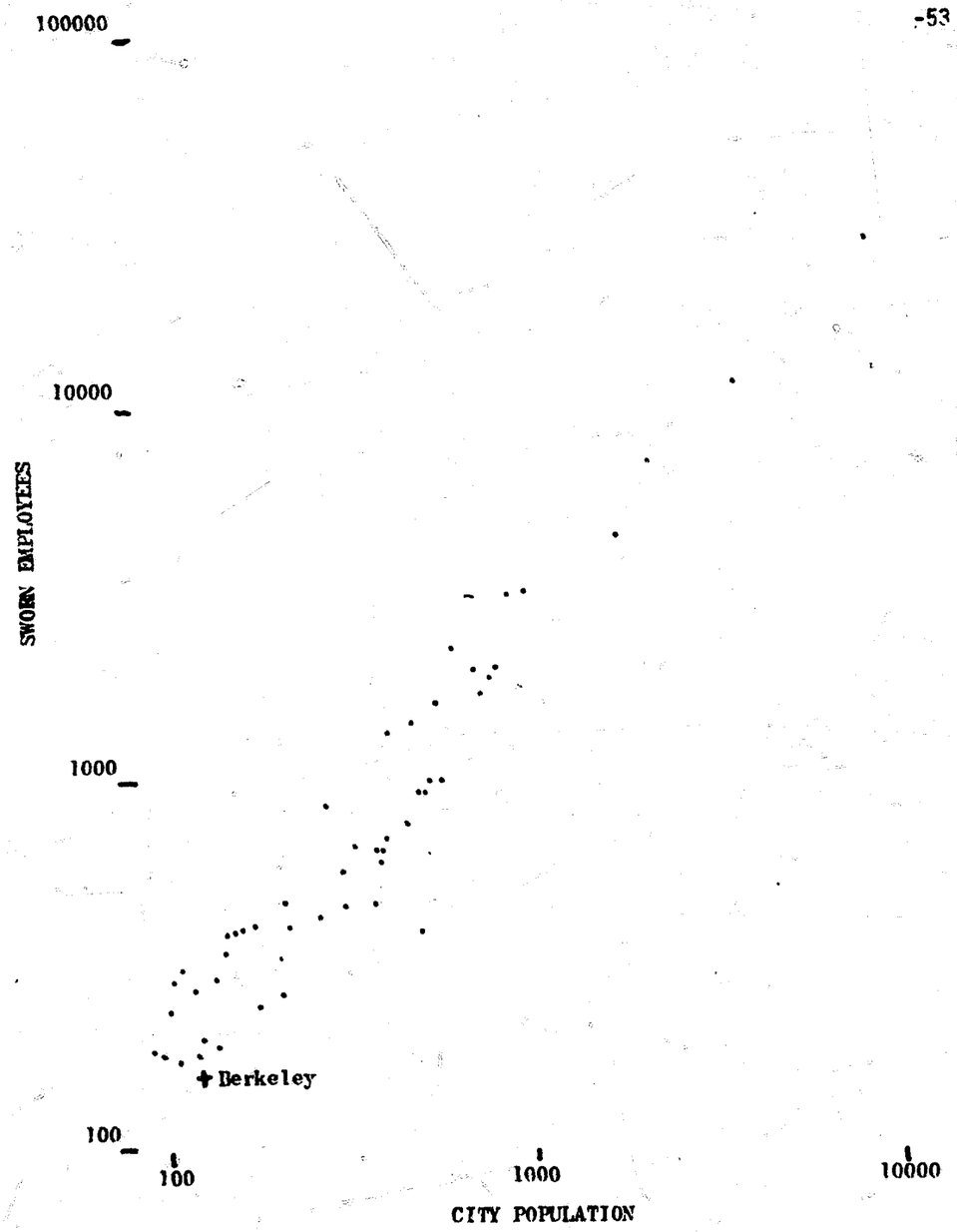


⊙ Cities with 100,000 to 250,000 population
\+ Cities over 250,000 population
• Berkeley (1968 estimated population 122,000)

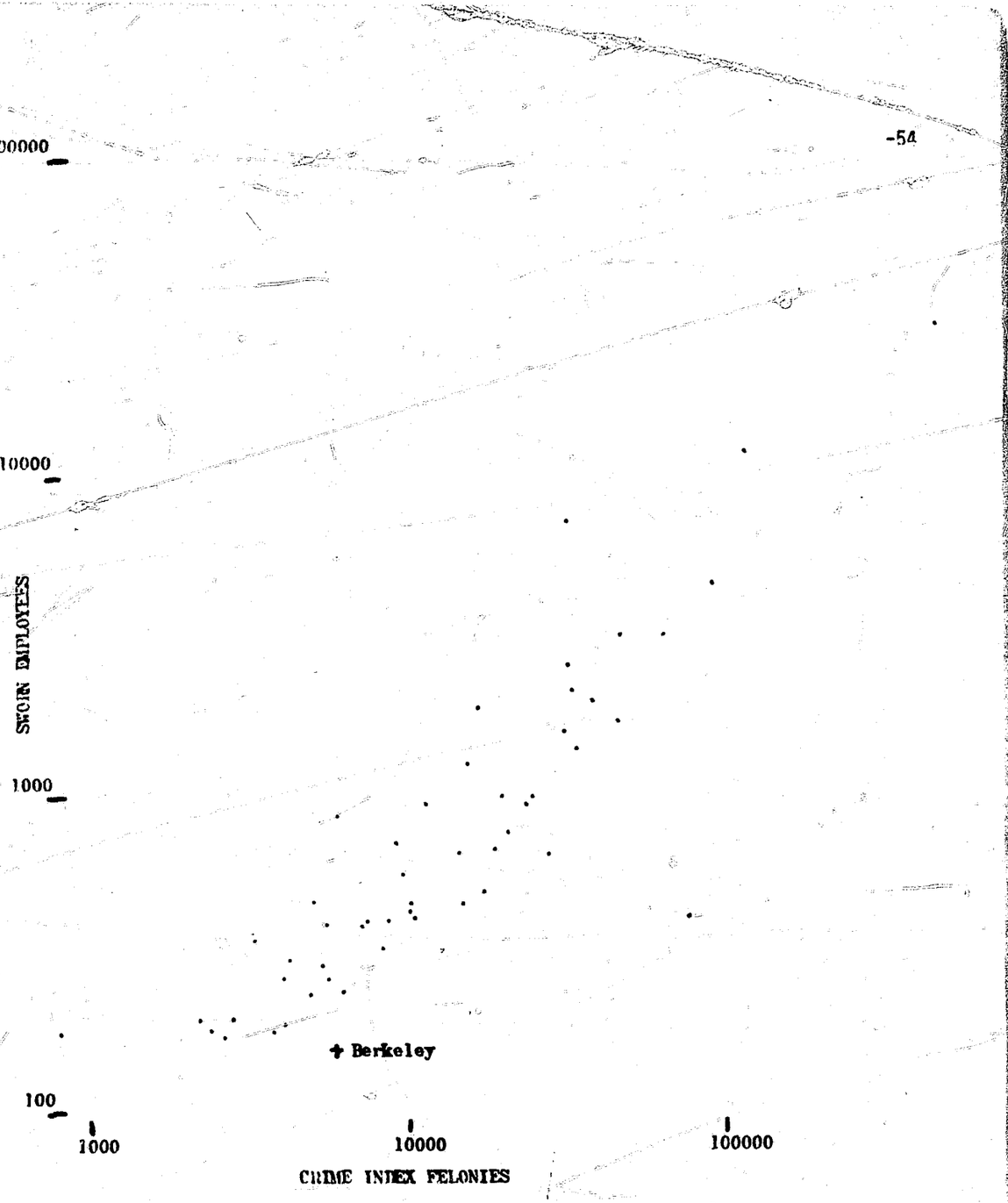
GRAPH 6c ARREST RATE COMPARISONS



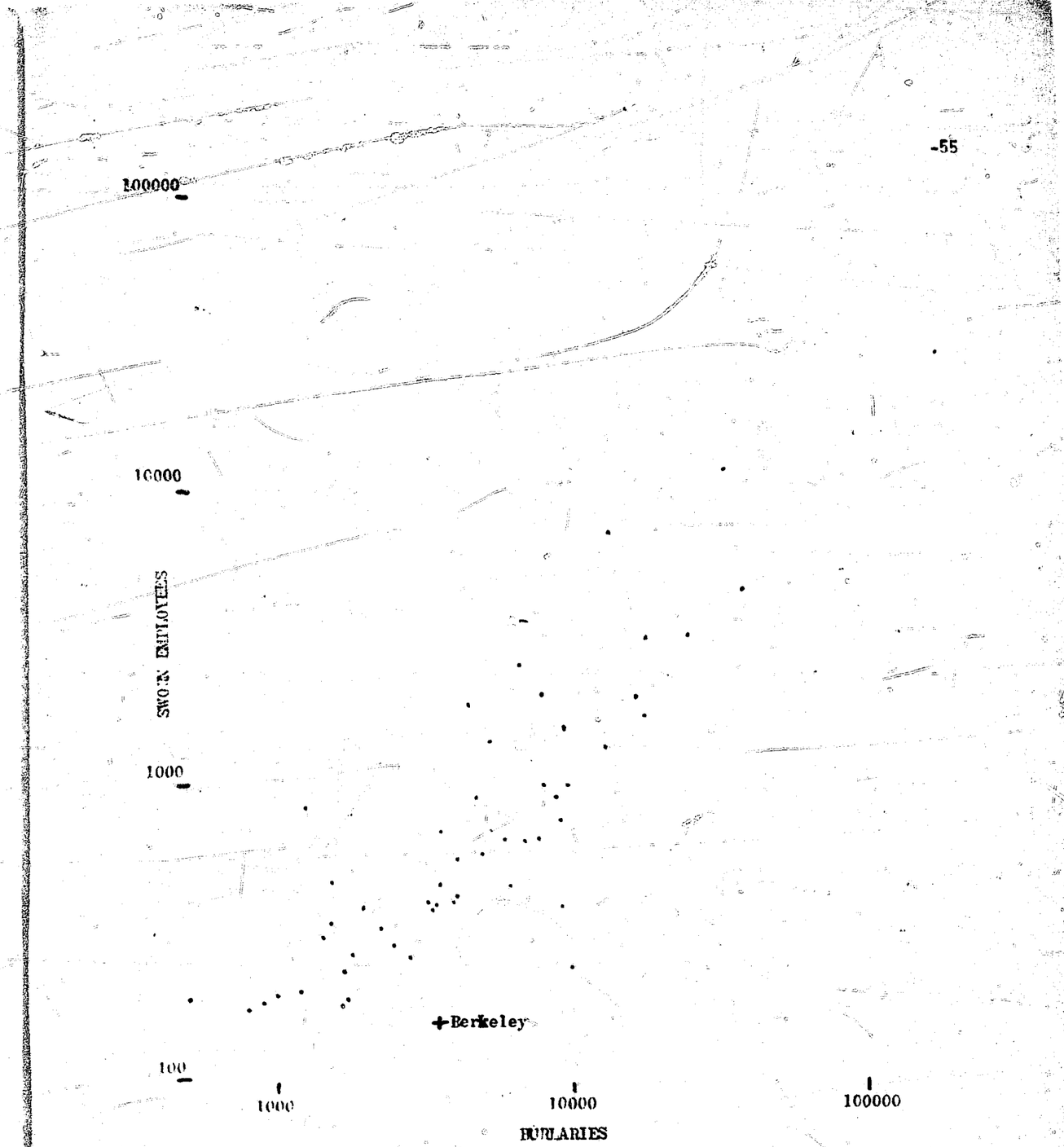
GRAPH 7 POPULATION AND POLICE DEPARTMENT EMPLOYEE COMPARISON



GRAPH 8 POPULATION AND POLICE DEPARTMENT OFFICER COMPARISON



GRAPH 9 CRIME INDEX FELONIES AND POLICE DEPARTMENT OFFICER COMPARISON



GRAPH 10 BURGLARIES AND POLICE DEPARTMENT OFFICER COMPARISON