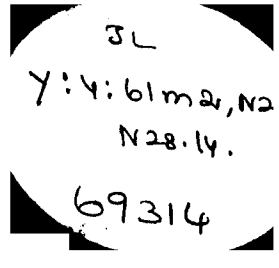
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VOL. XIV, No. 1 JANUARY-MARCH, 1941

THE POLICE JOURNAL

A Quarterly Review for the Police Forces of the Empire

ISSUED UNDER OFFICIAL PATRONAGE

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7/- per annum, ($2.50 United States only) including postage to any part of the World.

¶ *Changes of Address.* To facilitate the prompt receipt of each issue, subscribers are requested to notify the publishing office immediately of any changes of address or division.

Publishers and Distributing Agents:

THE POLICE JOURNAL

19 CURSITOR STREET, LONDON, E.C.4

Telegrams and Cables—"NUFOTOG, FLEET, LONDON"
Telephone—HOLBORN 6201 (private branch exchange)

American Agents:

PUBLIC ADMINISTRATION SERVICE
1313 EAST 60th STREET, CHICAGO, ILLINOIS, U.S.A.

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POLICE JOURNAL

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War Commentary

RETROSPECT

WAR is a time when lessons must be learned quickly if we are to profit from experience gained under the stress of rapid changes in the strategical situation. " Strategy," said the late Prime Minister in the House of Commons on a memorable occasion, " is the art of concentrating decisive force at the decisive point at the decisive moment." Modern war brings not only the various arms of the fighting services within the ambit of the strategical plan, but every section of Civil Defence, and indeed of the community as a whole. War also brings its additions to the common vocabulary; among them is " total war," which seems to imply that the whole resources of the nation are involved in hostilities, active or passive though their part may be. But if at first the leaders of the German Reich thought that methods of " total war," as distinct from military action, would more quickly subdue the defences of those who resisted their rapacious acts of invasion and repression, they have found to their cost that in this country such measures merely stimulate the morale and resolve of the common people to a resistance and endurance which is traditional of (one might say almost peculiar to) the British race.

The " little man " of London, of Dover, of Coventry, of the industrial centres of the midlands and the north, and of the remote rural areas of the south and west, has even surprised himself by his own readiness to adapt his work and leisure to the new conditions. Moreover, he has learned to shoulder the burden of his own defence and the protection of his home, countryside and nation without any of that payment for his

hire which he is accustomed to demand from a normal employer. The common people, not least those in the humbler ranks of society, have taken the strain; they are standing their ground, and they will endure until victory is won.

Heavy demands have been made on the Police in recent months, but the members of the regular forces take no small pride in the help of their " auxiliaries " in the stern tests to which all have been subjected. Hardly a branch of the public service exists to-day which is not augmented by its auxiliaries, men or women as the case may be, who for the duration of the war have become temporary additions to the permanent members of the service. It is a traditional characteristic of English public service that so many people can be found (and, it must be added, only in a crisis, for comparatively few have sufficient foresight and enthusiasm before the emergency develops to demonstrate the need for their services) who with a considerable measure of success to take on the designation and functions of the permanent, professional, staff. In each of the fighting services women auxiliaries are performing splendid work, which women are specially fitted to carry out, thus releasing men for the executive and fighting arms.

In the police service the auxiliaries are not less valuable in the performance of police war duties. The majority of them, as special constables, give their services to the community in an unpaid capacity. In this they are following the tradition set by so many of a former generation in the war of 1914-18. In the present war women, too, are playing an increasing part in the police auxiliary services. Members of the Women's Auxiliary Police Corps are finding useful scope for their services in canteens, clerical and telephone duties and in other spheres in which policeman-power can be released for other duties.

Crime in War-time

Although statistical information on which conclusions can be based is not available, there seems to be a widely held view that in the earlier months of war crime decreased, and that even in black-out hours no noticeable variations from normal conditions were observed. Any statistics on the subject

would be valueless for the purpose of drawing comparisons with pre-war years, or with the corresponding periods of the last war; but careful analysis of the crime situation in each police district appears to be desirable, and all available preventive and detective resources focused on the task of tackling, energetically and skilfully, any acute problems which are found to exist, either generally or in specific areas. In every police district in war-time there are bound to be located a large number of strangers, with their inevitable percentage, small or large as the case may be, of persons of evil intent. The means for identifying them and their presence in a particular neighbourhood, a valuable aid to preventive police work in peace time, is now rendered doubly difficult, on the one hand by evacuation, military service, and the transfer of labour in connection with the war production effort, and on the other by the peculiar conditions of the black-out. That the problem is not more acute than it is may be due to several causes, not least of them the fact that unemployment and the recruitment to His Majesty's Forces of men in the appropriate age group has reduced the ranks of those " idle hands " whom the proverbial Satan is constantly waiting to employ.

The Home Guard

The recent changes in the organisation and command of the Home Guard were to be welcomed. The rapidity with which this force of armed volunteers was raised in the summer of 1940 will merit special mention in the historical records of these anxious times. In the early stages it was inevitable that errors and omissions should be made, but these were the mistakes of individuals, not of the force as a whole, and the Police can claim to have taken a valuable share in facilitating the enrolment of citizens in the newest branch of the Armed Forces of the Crown. The fortunes of war have enabled the Home Guard to gain time to organise, equip and train the men in its ranks for any task which may lie ahead. Whatever the task, it is plain that success in it will be helped if the liaison between the Police, in all ranks, and the Home Guard, in all ranks, is good and constantly improved.

War Charities

The enactment of the War Charities Act, 1940, to supersede the War Charities Act, 1916, is to be welcomed, as a further means for protecting the public from the activities of cunning and fraudulent persons who trade on the readiness with which English people respond to popular appeal when made in the name of some national, or nation-wide, movement. Under Section 1 of the Act, appeals to the public for donations or subscriptions in money or in kind to any war charity are unlawful unless the charity is registered or exempted from registration, and approval in writing has been given by the management committee or person responsible for the administration of the charity, or a duly authorised officer of the charity. Subject to exemptions respecting collections at places of religious worship, and charities for the blind (already governed by the Blind Persons Act, 1920), a " war charity " means any fund, institution, association or undertaking having for its sole or principal object or among its principal objects the relief of suffering or distress caused, or the supply of needs or comforts to persons affected, by war, either this or any other war (including that of 1914-18) in which His Majesty may be engaged.

The Act requires registration, and prescribes a code of supervision and safeguards, with penalties for offences of making false statements or false representation and breach of the regulations.

Police Wireless

The fruits of the patient and careful researches made in recent years to evolve a workable scheme for police wireless in every police district are ripening, and it is to be hoped that police authorities generally will grasp the opportunity to extend this useful addition to police communications in the most effective way possible. The merits of wireless communications for the Police have been discussed on a number of occasions in this JOURNAL, and the advantages of replacing various local and therefore widely differing types of equipment by apparatus which can be co-ordinated into a service to be shared by every force in the country are real and obvious.

The Police and the Law

Police in Harbour Towns

POLICE officers stationed in harbour towns may from time to time find themselves called upon to perform duties which, from the geographical situation of the place, are not so likely to be required of their colleagues. A brief survey of some of these duties may prove of assistance. Thus a police officer may find himself required to aid in the maintenance of discipline in the Navy. Readers are no doubt aware that under section 9 of the Naval Deserters Act, 1847, a police officer can arrest and bring before any justice any person belonging to the Royal Navy whom he reasonably suspects of being a deserter or improperly absent from his duty. It is perhaps not so well known that a police officer may be required to execute a warrant issued under the Naval Discipline Act, 1866. By section 50 of that Act any officer in command of one of His Majesty's ships or any senior officer of the Royal Navy present at a port may issue his warrant, which may be addressed to any person, requiring such person to take the person named in the warrant on board a ship. In order to execute the warrant the person executing it may use force. Refusal to execute the warrant would make the person so refusing liable to punishment under the Naval Discipline Act (see section 51). It should be added the only persons who can be apprehended under such a warrant are of course persons subject to the Naval Discipline Act; which means substantially persons in the Navy or in any of the Naval Reserves.

Somewhat similar duties arise in respect of the Merchant Navy. Thus under section 222 of the Merchant Shipping Act, 1894, an officer of the Merchant Navy may call upon a police officer to assist him in conveying a deserter on to his ship. In respect of a British ship such assistance must be given without a warrant on the verbal request of the person seeking to apprehend the deserter; but a deserter from a foreign ship can only

be arrested on a warrant. The Courts of this country issue such warrants only on behalf of foreign nations with whom there are reciprocal arrangements for the arrest of such deserters (Merchant Shipping Act, 1894, section 238).

Another and entirely different sphere of duty in which a police officer in a harbour town may find himself called upon to act is in assisting customs officers in the enforcement of the customs laws. By section 205 of the Customs Consolidation Act, 1876, an officer of customs engaged in the execution of a search warrant for uncustomed or prohibited goods " may if he sees fit avail himself of the service of any constable or police officer "; and the section goes on to provide that such officer is required to render assistance accordingly.

It will be recollected that English courts can try offences committed not only within territorial waters (*i.e.* the three-mile limit) but also any crime in a British ship on the high seas. This jurisdiction was originally vested in the Lord High Admiral. By a statute of the reign of Henry VIII (Stat. 28 Henry VIII c. 15) the common law judges were to be called in to assist by a separate commission issuable on the occasions of such cases. By Acts of 1834 and 1844 (the Central Criminal Court Act, 1834, and the Admiralty Offences Act, 1844) such offences can be tried at the Central Criminal Court and at any Assize. Further, each of the important Consolidation Acts of 1861 (the Offences Against the Person Act, the Larceny Act, the Forgery Act, the Malicious Damage Act) contains a provision by which the indictable offences mentioned in each of these Acts is triable " in any county or place in which the offender shall be apprehended or be in custody." The practical effect of this legislation is that upon an indictable offence being committed at sea by a person who is not dealt with under the Naval Discipline Act the delinquent will be kept in custody until port is reached, when he will be handed over to the police with a view to his being charged and tried under any of the above Acts.

A fairly recent example of a case of this kind was *R.* v. *Devon Justices* (1924), 1 *K.B.* 503, in which the High Court held that the Devon Justices had jurisdiction to commit for trial at Devon Quarter Sessions a person charged with

embezzlement on a ship of the Royal Navy in the Firth of Forth, the accused having been brought into port in Devon where he was handed over to the Devon constabulary.

With respect to offences by foreigners on foreign ships within British territorial waters it was held in 1876 by seven judges to six (in *R.* v. *Keyn*, 2 *Ex. D.* 63) that such crimes were not triable in this country. In that case the master of a foreign ship had run down a British ship, causing casualties, in circumstances rendering his act one of manslaughter by negligence. Parliament considered that such persons should be amenable to the jurisdiction of the Courts of this country and for this purpose enacted the Territorial Waters Jurisdiction Act, 1876. By section 2 of that Act—

> " An offence committed by a person whether he is or is not a subject of [His] Majesty, on the open sea within the territorial waters of [His] Majesty's Dominions, is an offence within the jurisdiction of the Admiral."

By section 7 of that Act the jurisdiction of the Admiral is defined as the jurisdiction of the Admiralty Courts of England and Ireland, and the section then provides that—

> " for the purpose of arresting any person charged with [such] an offence . . . the territorial waters adjacent to the United Kingdom . . . shall be deemed to be within the jurisdiction of any judge, magistrate or officer having power . . . to issue warrants for arrest or to arrest persons charged with offences committed within the jurisdiction of such judge, magistrate or officer."

The exact meaning of the above words has not received judicial interpretation in any reported case. They certainly give power to a police officer, acting on a magistrate's warrant of arrest, to arrest a person on the sea within territorial waters adjacent to the area within the officer's constablewick, and would seem to enable a police officer, as an officer having power of arrest, to arrest without warrant in proper cases in territorial waters persons whom he could have so arrested on land adjacent to such territorial waters.

Recent Judicial Decisions

Danger from Unattended Vehicle

Maguire v. *Crouch*

THE above case appears to be the first in which the High Court has been called upon to construe sec. 50 of the Road Traffic Act, 1930. As the interpretation given to this section by the High Court will henceforth be binding upon all inferior courts (*i.e.* petty sessional courts and courts of quarter sessions) as well as upon the High Court itself, a brief account of the decision and of the facts from which it arose may be of use to readers of this JOURNAL.

The facts proved or admitted in the course of this case were that, on November 6th, 1939, Mr. Maguire, the appellant, who was the driver of a trolley-bus owned by the Brighton Corporation, left it on its proper side of the road for a few minutes. Whilst he was away the vehicle began to move forward down a slight hill, travelled across the road and collided with a post. The driver then got back to the driving seat, but before he could regain control of the vehicle it had collided with a pedestrian. The cause of the vehicle moving was that the driver had failed to apply the hand-brake fully, this being the only and the proper means of effectually securing the vehicle.

Thereafter the appellant was charged by the respondent, a police officer, with breach of sec. 50 of the Road Traffic Act, 1930, the terms of which are as follows:

> " If any person in charge of a vehicle causes or permits the vehicle or any trailer drawn thereby to remain at rest on any road in such a position or in such a condition or in such circumstances as to be likely to cause danger to other persons using the road, he shall be guilty of an offence."

The information against the appellant charged him with permitting a vehicle (namely the trolley-bus) to remain at rest in such circumstances as to be likely to cause danger to other persons using the road.

Upon the above facts being proved before the Brighton magistrates, they convicted the appellant and fined him £5. Against this conviction the appellant appealed to the Recorder of Brighton (being the appropriate court of quarter session), who quashed the conviction but stated a case for the opinion of the High Court.

The ground upon which the learned Recorder allowed the appeal was that the section appeared to relate to danger caused by vehicles whilst " at rest," and the danger in this case had only arisen after the vehicle had begun to move.

In the High Court the appeal by the prosecution was allowed and the conviction restored.

The leading judgment was delivered by Viscount Caldecote, C.J., who, after stating the facts, said that although the section might have been enacted primarily to deal with the danger caused by vehicles whilst they were at rest, the words of the section were sufficiently wide to cover the present case. The vital words were " likely to cause danger," and not " causing." In this case the danger had arisen when the vehicle began to move; but the danger was likely when the driver left the vehicle without putting the hand-brake into such a position as would effectually secure it. He had, therefore, left it " at rest " in such circumstances as to be likely to cause danger to other persons using the road. The other members of the court, Hawke and Humphreys, JJ., concurred.

Capture of Enemy Property

Police v. *Harry Foulds*

Does property captured from an enemy become the property of the person effecting the capture or is it the property of the Crown? No doubt most persons had been under the impression that the days when a private person could take whatever enemy property he could lay hands on as his " booty "

had long ago vanished. However, the argument that articles found in the possession of a German airman were the property of the captor was seriously put forward by counsel at Chatham Police Court on November 7th when one Harry Foulds, a member of the Home Guard, was charged with stealing a German pistol, a clip of ammunition and a German flying helmet.

There is not much authority upon the point, but such as there is certainly supports the argument of counsel. According to the press reports of the case counsel cited a judgment from the reign of William III and a passage from Blackstone's *Commentaries*. The judgment from the reign of William III was presumably *Rex* v. *Brown* (1697, 12 *Mod.* 134) where, contrasting the Admiralty law of prize as to enemy goods taken on sea, the Court said:

> " And it was resolved by the whole Court that though, if the goods be taken from an enemy, it vests the property in the party taking them, by our law; yet by the Admiralty law . . ."

One of the judges who was a party to this judgment was Holt, C.J., whose views of the law on many subjects are still regarded by judges to-day as of weight. The passage in Blackstone's *Commentaries* dealing with the subject of the acquisition of property from an enemy is as follows:

> " It hath been said that anybody may seize to his own use such goods as belong to an alien enemy. For such enemies, not being looked upon as members of our society, are not entitled during their state of enmity to the benefit or protection of the laws; and therefore every man that has opportunity is permitted to seize upon their chattels, without being compelled as in other cases to make restitution or satisfaction to the owner. But this however generally laid down by some of our writers, must in reason and justice be restrained to such captors as are authorised by the public authority of the state residing in the Crown and to such goods as are brought into this country by an alien enemy after declaration of war, without a safe conduct or passport." (Book II (4th ed. publ. 1770), p. 401.)

It is doubtful from this passage whether Blackstone, by qualifying the general statement by restricting the capture to persons authorised by the Crown, does not negative it. For such persons, presumably acting as servants of the Crown, would automatically vest their acquisitions in the Crown in accordance with the general law relating to servants and agents, by which property acquired by such persons in the course of their duty vests not in themselves but in their employer.

Fortunately it was not necessary for the magistrates to come to any determination of law in this case as they acquitted the defendant on the facts.

The legal problem, however, remains. The notion of private persons pillaging enemy property for their private gain is quite repugnant to modern notions. It is hoped therefore Parliament may find time to pass a brief enactment declaring that all enemy public property found on British soil automatically vests in the Crown.

Criminal Law and Practice in Scotland

CULPABLE HOMICIDE—SOLDIERS AND THE PUBLIC

A SOLDIER, although subject to military discipline, is still within the reach of the ordinary law of the land. Should he commit a crime or offence punishable by the criminal courts, he does not escape the consequences by saying " I'm a soldier; you can't touch me." Moreover, the courts will apply to his conduct the usual standards and will ignore a plea that he acted in good faith and did no more than what he considered to be his duty as a soldier. How far he can secure immunity by sheltering behind an order issued by his superior officer is a question of circumstances. These observations are pertinent to rulings given by judges of the High Court in the recent cases of *H.M. Advocate* v. *Macpherson* and *H.M. Advocate* v. *Harrington*.

Macpherson, the accused in the first of these cases, was a sergeant in the Royal Air Force. On July 11th he was granted forty-eight hours' leave from his station in England. He arrived in Edinburgh next day and spent part of the evening in a roadhouse near his home. There he met some friends and consumed liquor—four half-pints of beer and two or three small whiskies. On leaving the roadhouse about 10 p.m. he took with him two bottles of beer. What became of these was not proved at the trial.

About midnight the air raid sirens sounded. Shortly thereafter, accused, with rifle and ammunition, took up his stand at a point in Willowbrae Road, a main road giving access to the centre of the city. On the approach of a car, which was being driven in a normal manner, the accused issued a challenge, in response to which the driver pulled up. The driver was an A.F.S. patrol officer, whose duty, on the sounding of the siren, was to collect by car certain lady

telephonists. Notwithstanding that the driver made his identity and business clear—and, indeed, he offered to produce his credentials from his pocket, but, on making a movement to do so, was told to put his hands up—accused pointed his rifle through the car window, told the driver to put out his lights and go into a side road, and said that, failing this, he would not hesitate to shoot. The driver obeyed.

Just then a second car approached. Although not clearly marked as such, it was a police car returning to headquarters with a complement of officers, including Mr. R. Thomson, Assistant Chief Constable. The car had regulation lights and was being driven at not more than 40 m.p.h.—a legal speed for a car on police duty. Accused challenged the car—indeed the burden of the evidence suggested repeated challenges, although none was heard by the occupants of the car, which maintained its course. Accused thereupon fired at the car, fatally wounding Mr. Thomson. He was at once placed under arrest, despite vehement protests on his part. According to most of the witnesses, he did not appear to appreciate the seriousness of what he had done and, according to some, boasted of his powers as a marksman and that he had brought down two Heinkels. Accused maintained to the arresting officer that no car was entitled to be on the road while an air raid warning was on and that he was obeying the instructions of his Wing Commander. Witnesses varied greatly in their estimate of accused's condition—drunk or sober—at arrest.

On these facts a war-time jury of seven members unanimously found accused "guilty as libelled" on an indictment charging him with (1) assault and (2) culpable homicide. The verdict was coupled with a strong recommendation that the sentence should be as lenient as the court could make it. The presiding judge—Lord Aitchison, Lord Justice-Clerk—passed sentence of six months imprisonment.

In his charge to the jury Lord Aitchison dealt at some length with the evidence as to accused's sobriety or insobriety, explaining to the jury that the question to which they should address their minds was not whether he was, in the crude sense of the term, " drunk," but whether they were satisfied that the

effect of the drink which he had consumed was to impair his judgment, with the result that he acted as he would not have acted in his sober senses. If that were proved, it would go a long way towards bringing home the charge. In making up their minds, the members of the jury were entitled to have regard to (1) the evidence as to the liquor consumed and (2) the evidence as to the accused's actings. When told by the driver of the first car that he was a fireman, would not a soldier, if in full possession of his faculties, have told him to proceed at once to his post?

Lord Aitchison went on to deal with accused's status as a member of H.M. Forces. " If," he said, " there had been a situation of real emergency, or a threat to a place of military importance, such as a railway bridge, and a soldier on duty were to act strongly, a jury would not be disposed to weigh his conduct in too fine scales." In such circumstances a soldier might well be entitled to act on his own responsibility. It was, however, quite another thing to say that, once an air raid warning had sounded, a soldier on leave was entitled to take drastic action towards motorists merely because, in his opinion, some road regulation was being contravened. A soldier on leave could not take human life and then seek to escape responsibility by saying that he thought he was doing his duty. It would be a serious thing if the community were to be at the peril of soldiers discharging their rifles when their challenges were unheeded. The question was whether accused, in firing at the car, acted with gross and wicked recklessness and without reasonable excuse. Accused had maintained, but had not proved, that he was acting on general verbal instructions given by a Wing Commander. " I cannot conceive any responsible officer telling his men that if cars did not answer their challenge and stop during an air raid they were entitled to discharge firearms at them," said Lord Aitchison.

Harrington, the accused in the second of the two cases referred to, was a soldier on sentry duty on a public road in the north of Scotland at a point near the entrance to a military camp. He also was charged with culpable homicide on the allegation that, while under the influence of drink, he recklessly

discharged a rifle at a motor-car, fatally wounding one of the passengers. The case, however, was not allowed to proceed to its normal conclusion. On the second day of the trial the Advocate-Depute in charge of the Crown case intimated that he would desert the charge in view of evidence led that accused was acting under orders.

In directing the jury to return a formal verdict of not guilty, Lord Keith said that he would be sorry to think that the views expressed by the lance-corporal of the guard as to the military duties of a camp sentry were the accepted views of the military authorities. The lance-corporal had said that under present active service conditions a sentry charged with guarding a camp entrance was entitled, between dusk and dawn, to shoot to kill at any car-load of passengers whose driver had not happened to hear three verbal challenges when passing along a public highway in quite unsuspicious circumstances. " We are not under martial law," added the judge, " and unless it could be shown that such shooting was justified by circumstances or proceeded from an order by a more competent authority, the person so acting is liable to be indicted for culpable homicide, if not for murder. Fortunately for the accused, he acted upon an order which he was bound to obey." Lord Keith approved of the Crown's action in deserting the charge.

When is an Interview " Private "?

Cheyne v. *McGregor and Dunnigan*

In the October issue of this JOURNAL a report was given (p. 382) of the earlier stages of this case, in which the Sheriff at Stirling dismissed a complaint charging McGregor and Dunnigan with theft on the ground that, while in custody in a police cell, McGregor had been refused a *private* interview with his law agent. The Sheriff, it will be remembered, brushed aside the argument that the refusal to allow a private interview was not fatal to the proceedings for the reason that accused had suffered no prejudice. The Procurator-Fiscal appealed.

All three judges sitting at the hearing of the appeal in the

High Court of Justiciary were agreed that the right conferred on an accused by section 15 of the Summary Jurisdiction (Scotland) Act, 1908, is important and valuable; that, in every case, a person in police custody following arrest should be allowed, if he so desires, an interview with an agent which is private in the fullest sense—no police officer remaining within earshot; and that, in the case under review, such private interview was refused by the police. The judges, however, differed on the question of the effect of depriving an accused of this statutory right. Two judges (Lords Aitchison and Jamieson) held that where it could not be contended that an accused had been prejudiced in the preparation of his defence—as in the present case, where McGregor, being released on bail next day, had ample opportunity to consult his agent before being called upon to plead to the charge—the effect was not to render incompetent all subsequent proceedings. The proper course to be adopted when such a point was raised was to offer accused an adjournment, so that he might instruct his agent fully and in complete privacy. The Sheriff, therefore, had been wrong in dismissing the complaint and the case must now be remitted to him for further procedure.

Lord Mackay dissented, taking the view that refusal of a private interview was a violation of a right of great constitutional importance and that it must have the effect of nullifying all subsequent proceedings. Any question of prejudice was, in his opinion, irrelevant; nor could so serious a defect be cured by adjournment.

Whichever be the true view, it is clear that the only safe course for a police officer in charge of prisoners is to accede at once to any request for an interview with an agent and to see that complete privacy is conceded. It is easy to see that an agent might argue that his client had suffered prejudice were he denied access in circumstances which allowed them to discuss the charge freely. One further point is worth raising. What is to be done where the prisoner is detained on a charge of murder? Must the officer take the risk of allowing the accused, for whose safe keeping he is responsible, out of his sight? We think not. In such a case it should be possible to arrange that a police officer, while remaining out of earshot,

should keep the prisoner in view and be in a position to intervene in the event of any untoward happening.

Money in Police Hands

Guthrie v. *Morren.* 1940 *S.L.T.* (*Sh.Ct.*) 33

On June 13th, 1938, Guthrie bought from motor engineers at Duns a second-hand car for £120. He gave a cheque in payment. Two days later he sold the car for £100. The cheque was dishonoured, he having no account at the bank upon which it was drawn. On June 18th Guthrie was arrested on a charge of fraud and was found to have in his possession £68 10s., which sum was retained by the Edinburgh police. Guthrie was sentenced to six months imprisonment.

Guthrie's wife, who held decrees against him, arrested, in the hands of the Chief Constable of Edinburgh, monies due to Guthrie up to the amounts of the decrees. Guthrie, however, writing from prison to the Chief Constable, demanded his money. To complicate matters still further, the motor dealers referred to also put forward a claim for payment, as did another creditor.

Mrs. Guthrie, having placed her arrestments, took matters a stage further by raising an action of furthcoming against the Chief Constable—*i.e.* an action for payment to her of the sums in his hands; whereupon the Chief Constable, in order to obtain a judicial ruling upon his position, himself raised an action of multiplepoinding—that is to say, he paid the money into court and asked for the court's advice as to payment.

After a very full debate in Edinburgh Sheriff Court, Sheriff Robertson held (1) that the arrestments placed by Mrs. Guthrie were incompetent; (2) that the claims made by creditors must be rejected; and (3) that Guthrie was not deprived of his legal possession of the money simply by its having been taken from him at arrest and was entitled, on demand, to have it returned to him or to his accredited agent.

The Diesel Dumper

1. Is it a Motor Vehicle?

Macdonald v. *Carmichael*

Diesel dumpers were described by one of the judges who heard this appeal as " simply large tubs on wheels restricted

by the nature of their construction to a limited and special use" and by another judge as "mechanically propelled tipping barrows." They are manufactured by Motor Rail Ltd., were put on the market some two years ago, and were intended to take the place of the wagons moving on small-gauge temporary rails which until then were a feature of road constructional operations. They are designed to work on rough ground in conjunction with mechanical excavators. They are used solely in connection with road construction and are not constructed to carry goods on an ordinary highway; but they are capable of, and used for, carrying road-making material along short stretches of road (which may, at the same time, be open to the public). When so used, they are loaded with earth and stones at the excavation point and driven by their own power to another point where, say, an embankment is being formed. They are mechanically propelled, have pneumatic tyres, and consist of a Diesel engine carrying in front an iron skip with raised sides and tapered at either end. The skip may be tipped forward, so as to allow the contents to be dumped out. The driver sits in a single seat at the rear and steers by a wheel. When the skip is fully loaded, the driver's view forward is obstructed and he must look along the side of the load. The dumpers have four forward gears and reverse and a maximum speed of 10 m.p.h. They have no windscreen, mirror, speedometer, springs, lamp, dynamo or battery.

The question raised in this appeal was whether a dumper of the type above described was a "motor vehicle" to which the provisions of section 35 of the Road Traffic Act, 1930, applied. The High Court judges held that, although mechanically propelled, it was not a "motor vehicle" as defined in section 1 of the Act of 1930, being neither intended nor adapted for use on roads.

2. Is it a "Road Construction Vehicle"?

Orr v. *Carmichael*

In this further appeal, which involved the same contractor as respondent, the judges of the High Court held that the Diesel Dumper above described was a "road construction vehicle" within the meaning of section 10 of the Finance Act, 1936, and that, therefore, a Road Fund Licence was not required.

Stellionate and Real Injury

It must be many years since the term "stellionate" was heard in our criminal courts; yet there seems little doubt that it still remains a crime punishable by the common law of Scotland. So counsel argued in course of the appeal in the Perth poisoning case, although he conceded that, in order to find an apt precedent, he had to go back nearly one hundred years to the case of *H.M. Advocate* v. *Brown and Lawson*, 1842 (1 Broun 415). The crime there libelled consisted of "administering an excessive and injurious quantity of ardent spirits to a child of tender years to the serious injury of his person and danger of his life" and the indictment, which the court seems to have accepted without question, alleged that accused did administer to a boy of six years a quarter of an imperial pint of whisky and that the boy became intoxicated and insensible, was seized with convulsions or epileptic fits and continued in a state of insensibility for two days and that he had become permanently liable to convulsions or fits and that he was thus severely injured in his person. In a still earlier case, the crime consisted of tying a man with ropes and keeping him in that condition all night, so that he was bruised and blistered, his arms were paralysed and his life was endangered; while, in 1833, an indictment set out that it was a crime to administer a drug to a member of the public to the injury of his person, more especially when this was done to prevent him from following his lawful business or exercising his political rights.

The argument tabled in the Perth poisoning case (*H.M. Advocate* v. *Millar*) was that the trial judge had erred in failing to direct the attention of the jury to the possibility of returning a conviction of the crime above described. Accused had been convicted of attempted murder by sending to an elderly lady a box of chocolates into which he had inserted potassium permanganate crystals. There was evidence before the jury on which they could hold that he had sent the chocolates

along with a letter in which he hinted that they should be consumed, several at a time, in coffee. The judge, in charging the jury, directed them that there were two possibilities, *viz.* (1) that the whole thing was a prank and (2) that the intention was to poison, and so kill, the lady. At the appeal against conviction, it was contended that the jury could competently have held proved part of the indictment only, *viz.* that accused sent the chocolates with intent to poison the lady, in the sense of doing her physical injury or annoying her, but not with the intention of killing her, and that the judge should have pointed out this possibility in his charge. The High Court judges, however, rejected this argument, refusing to lay it down as matter of law that a trial judge was bound, in every case, to bring every possible interpretation of the facts to the jury's notice.

Studies in Identification and Reconstruction. No. 9

By SYDNEY SMITH, M.D.

Department of Forensic Medicine, University of Edinburgh

IN each of the former cases which I have recorded I have endeavoured to draw attention to the value of more or less minor points, the observation of which has enabled us to build up a case.

The present study indicates how the discovery of certain minute traces of blood in a house pointed the way to a fairly complete reconstruction of the crime. The case in itself is relatively simple.

On May 21st, 1920, at 6 a.m., an engineer who was working on the wharf at Alexandria observed a sack floating on the sea. It was pulled in and a portion of a human body was seen projecting from the sack. The portion consisted of the lower half of a female body, naked except for a pair of socks with men's suspenders attached to the legs. Somewhat later the same morning another sack was found in the same area, and the upper portion of a female body was found in this sack. This was dressed in a white chemise and a red dress. There was a wedding ring on the left ring finger.

The two parts were transferred to the mortuary for examination.

On examination at the mortuary the two parts were proved to be portions of the same female body, the division having taken place by means of a saw through the middle of the abdomen.

Two roughly cut wounds were found on the head. The first ran from the left side of the forehead to the junction of the left parietal bone with the occiput, causing a comminuted fracture of the bones and laceration of the brain.

The second ran from the top of the head to the lower third of the occiput, causing a comminuted fracture in the occipital bone and protrusion of parts of the brain.

There were also contused wounds on the right eyebrow and the right temple, associated with a comminuted fracture in the bones underneath.

The cut wounds appeared to have been inflicted with a moderately sharp axe, and the contused wounds might readily have been caused by blows from the butt end of the same instrument.

Blood clots were found underneath the scalp penetrating all the tissues to the periosteum of the skull bones.

Coagulated blood was found in the tissues about the right eyebrow and right temple.

All these injuries and fractures were made shortly before death.

There were no marks of violence in the tissues of the neck, the larynx or wind-pipe; the hyoid bone was not fractured.

The stomach contained a large quantity of food matter, consisting of bread, orange, meat and rice, which was not completely digested.

Nothing of importance was found in the other viscera.

The separation between the two halves of the body was made two inches above the umbilicus. The cut passed transversely through all the tissues and organs of the body and cut the spine through the ninth dorsal vertebra.

No bloody extravasations were found infiltrating the cuts of the skin, the soft tissues underneath, the intestines, the abdominal viscera or the vertebral bones, and it may be assumed that these were made after death, and probably sufficiently long after death for coagulation to have occurred in some of the vessels.

From the investigation up to this point we have been put in possession of a good many facts, and we must see how far these help us towards the identification of the victim, the manner, time and place of her death, the conditions surrounding the disposal of the body, and also what other matters connected with the body might aid in arriving at some conclusion or suggestion as to the place of the crime.

Identity

The post-mortem examination showed that the body was that of a young, good-looking European woman, about 30 years of age, with fair hair, of whom good photographs could be taken. She was of medium height, 5 feet 4 inches, and well developed.

The absence of scarring on the surface of the abdomen, the condition of the breasts and of the uterus, indicated that she had never borne a child, although the general appearance of her parts indicated that she had been accustomed to habitual sex intercourse. The wedding ring on her finger suggested the possibility of her being a married woman, but in various ways the suspicion was raised that she might be a prostitute. If so, it was likely that her identification might be only a matter of inquiry in the proper quarters.

The dress consisted of a chemise and red overdress, and showed no identifying marks, but it might be expected that the socks with men's suspenders attached might be helpful at a later period.

The Cause of Death

The cause of death was quite obvious. She had been struck a series of blows on the head with an axe or similar weapon which had fractured the skull and comminuted the brain. Death must have occurred almost immediately after the injuries.

Time of Death

The body was found about 6 a.m., and the post-mortem examination was commenced about 11 a.m. It was then completely stiff and free from the early signs of putrefaction. The weather in Alexandria in May is quite hot and rigor mortis might be expected to begin to disappear in about twenty-four hours after death.

The general conditions suggested that the body had been dead for something in the region of eighteen hours, and that it had been in the water for about half a day.

The food in the stomach consisted of meat, rice, bread

and orange. Digestion was commencing, and it might be accepted as a working hypothesis that the woman had been killed about an hour or so after her last meal. The nature of that meal should, of course, afford useful evidence at a later period in the case.

From these various facts it might then be assumed that the woman had been killed somewhere in the early evening of the night before, and within about an hour of the evening meal.

Disposal

The condition of the limbs and body and the state of the larger and smaller vessels indicated that it had been lying flat for a few hours after death, sufficient time to allow stiffening to take place and the blood to coagulate. It was then cut into halves by means of a saw, placed in sacks and thrown into the sea.

Place of Death

The sacks, which were identical, suggested an obvious line of approach. They were both rice sacks which had belonged to the Army authorities and were branded " Base Supply, Basra." Of course, great numbers of these sacks were disposed of from time to time by the authorities, and though almost any sack merchant might have a number of that particular type of sack, an enquiry amongst military contractors and sack and cereal merchants should certainly prove of value.

The effect of the tide, currents and wind was investigated, and from those who had experience in these matters an opinion was obtained about the distance and direction of movement of the body. This indicated that the body must have been thrown from a boat, or thrown in from the shore, some miles along the Ramleh front. Watermen gave a fairly close approximation of the place where it might have been thrown in, assuming that the time when it was thrown in was correct. This we suggested was somewhere about midnight.

Meanwhile, the investigating authorities were successful in finding a person, two persons in fact, including one police officer, who recognised the photographs of the deceased. By a strange coincidence, the photographer who was asked to

photograph the remains recognised the body as that of a woman whom he knew as " Emma." He gave the address at which she lodged. From enquiry there it was learned that about a month before the crime, she went to live with a man known as John K——. Investigation showed that this person lived in a villa along the coast within the area suggested by the watermen as that from which the body may have floated. He was in business as an army contractor and dealt in sacks disposed of by the army authorities. John K—— was interrogated and confessed that the victim had been living with him for about a month, but that she left his house on the afternoon of the incident, taking all her belongings with her, and did not return. He stated that he knew nothing more about her. It was found that the socks and suspenders which he was wearing at the time were similar to those found on the woman, and being shown these he admitted that they were his, but stated that she had been in the habit from time to time of wearing his socks. It was obvious that no woman was likely to leave for a journey to town dressed as she was and with men's socks and suspenders on.

The accused's house was searched, and many sacks were found similar to the sacks containing the two parts of the body. No bloodstains could be observed on any of the sacks. No bloodstains could be found on any part of the house, the furniture or the clothing of the suspect. There were no signs indicating a struggle. No clothes or other articles belonging to the deceased could be found and a minute search failed to reveal the presence of an axe, a saw, or other instrument which might have been used either in the murder or in the disposal of the body. In short, nothing was found, with the exception of the sacks, which might be held to incriminate the accused. Information was obtained, however, from the cook, that the deceased had had a meal of meat, rice, bread and oranges about five to six o'clock before her alleged departure on the night of the occurrence. Other information was gathered with reference to the excessive barking of dogs in the house about midnight, and a servant of the suspect stated that his master had borrowed a saw from him and had not returned it.

The suspect was arrested, and a further examination of the dwelling by the laboratory was demanded. This inspection was carried out on May 29th.

In this examination a brownish stain was noticed on the front door leading into the hall. This stain looked suspiciously like blood and a rapid examination showed that it was blood.

Close examination of the door showed four blood-stained areas (Fig. 1) grouped on the surface of the door, two on the jamb, two on the panels.

Of the two on the jamb the upper showed a blood mark on the edge splashing to each side, namely into the jamb and forward towards the panel, indicating that some bloody object had struck against the edge of the door when the door was open. The object was struck against the door with a fair degree of force about 40 inches above the ground level.

Immediately below there is a line of blood which has run down the edge of the door from the splash above mentioned.

The two stains on the panels of the door were lightly streaked and about 5 inches long. The streaks showed that they were caused by a blood-stained object being drawn or brushed along the door from left to right.

These stains were all due to human blood which was recently shed. They could be produced only by something heavily stained with human blood striking against the door and brushing along it when it was open, the moving body passing from within the house outwards. They could be produced by a blood-stained object such as a sack carried over the left shoulder of an average-sized man, and it might be assumed with a considerable degree of certainty that it had been caused by some person carrying out something on his shoulder heavily stained with human blood. When a person walks, as you well know, if he advances the left foot, the shoulder on that side goes to the left; with the next step the shoulder passes towards the right and then again to the left on the next step. If something is being carried on the shoulder, especially if it is heavy, the tendency is, in passing through an aperture, to touch the side at spots corresponding to each

step. In this particular instance the character and position of the marks corresponded with this hypothesis.

The finding of these stains put an entirely different complexion on the case, for by no innocent means could one explain the presence of stains of this nature on the door. The hall where certain sacks had been found was tiled and at one point the tiles were cleaner than elsewhere, suggesting that it had been recently washed in one part only. Certain of the tiles were removed and a benzidine reaction for blood was readily obtained from the material between them.

No stains or signs of a struggle could be found in any other part of the house, and we came to the tentative conclusion that the murder had been committed in the hall, and that the body may have been cut up there. In that case there should have been a good deal of blood about, however, and the state of the material between the tiles did not suggest this.

Further investigation showed that one of the sacks in the hall was blood-stained inside. It was an army rice sack, labelled " Base Supply, Basra." It was 20 inches wide by 28 inches long. Near the bottom of the sack in the inside was a heavy blood-stain, 7 inches in diameter, and opposite to it on the other side of the sack there was a smaller area of blood, the whole suggesting that an object heavily blood-stained on one side had been placed in the sack for a short period, and had then been removed and the sack flattened out, thus causing the blood-stained area to come into contact with the opposite side. Sticking to the inner surface of the stains there were a good many particles of blood-stained sandstone, and a few hairs, which were similar to the hairs of the deceased. The blood was human blood. This raised the assumption that the woman's body had been placed in the bag head downwards with a lump of sandstone but that the body had shortly afterwards been withdrawn. The absence of general staining indicated that the body had not been cut up at that time.

The search was continued and traces of blood were found in the back premises of the accused's house. A stain found on a piece of timber, another on a garden roller, and a third on some stones were all due to human blood.

These stains led to the discovery of a disused covered

well, and when it was opened and examined it was found that there were in the well fourteen sacks, similar to sacks found in the house of the accused. These sacks gave a general reaction for blood. A number of articles of clothing were also found, all of which were identified as belonging to the victim, consisting of a dress, underclothing, shoes, stockings, a hat, a handbag with articles inside all of a certain value. In addition, two puttees were found attached to a projecting bit of masonry on the side of the well.

One of the puttees was profusely stained with human blood, disposed in such a way to appear as if it had been wrapped three times round an object the size of a human head, which was bleeding on one side.

The clothing of the victim was free from blood, and although a general and instant reaction to benzidine could be obtained from the well water, no precise test for blood could be obtained.

A possible motive for the crime was found in the fact that the wife of the accused, who had been in Europe, was to return to Egypt the week following the crime.

Taking all these circumstances into consideration, we might attempt the reconstruction as follows:

When John K—— found that his wife was about to return, he attempted to get rid of the deceased, and apparently a quarrel took place which resulted in the murder of the female. This occurred somewhere about six o'clock, since it was known that the evening meal had been taken at five o'clock. The identification of the substances in the stomach showed that that was the last meal taken.

The woman having been killed by a number of blows with a hatchet, the body was covered with sacks and left until about midnight. An attempt was made to push the body into a sack, but the sack being too small, the body was taken out and divided into two parts by means of a saw. This probably took place in the hall, and the bulk of the blood was retained by the sacks on which the body was lying. The puttee was probably used to prevent an excessive amount of blood being effused from the scalp wounds after the injury.

Round about midnight the two halves of the body were

PALM-PRINTS (see p. 31).

FIG. 1. The base of the palm is placed upon the block at the point indicated by the arrow, thus allowing the fingers to extend beyond the inked surface.

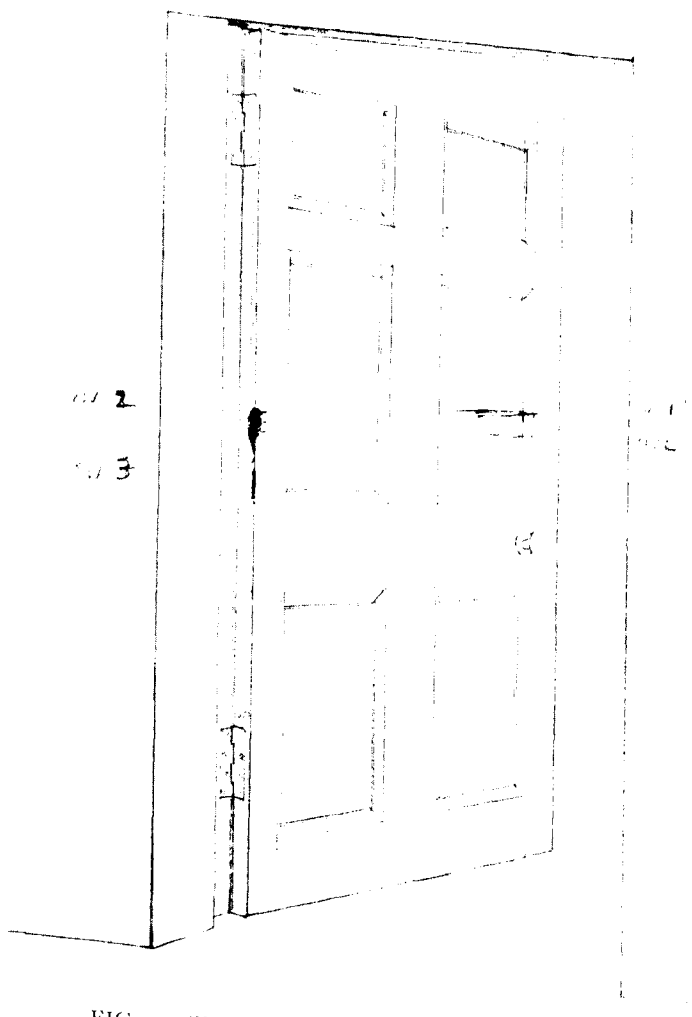

FIG. 1. SHOWING THE AREAS OF STAINING BY BLOOD.

carried through the front door to the sea, which was 300 or 400 yards away, and thrown in. The set of the current and tide then carried the remains to the harbour where they were discovered the following morning.

The hall was then cleaned up and partly washed, and the sacks, fourteen in number, which had been soaked with blood, were thrown into the well. The sack into which the body had first been placed was not obviously blood-stained outside and was forgotten. The whole of the clothing and effects of the deceased were then removed from the room and thrown into the well. The marks of blood found on the wooden plank, garden roller and the coping of the well were probably caused by carrying certain of the blood-stained articles, sacks or puttees from the hall where the murder occurred to the well.

The accused was tried at the Court of Assize on a charge of murder. An interesting feature of the trial was the adjournment of the full court, accused, witnesses, etc., to the scene of the crime, where a reconstruction on the above lines was demonstrated. It is an interesting speculation what the thoughts of the accused are in these circumstances, for obviously he is the only one who has an absolute knowledge of what took place. The value of removing stains intact was here demonstrated, for one was able to replace the pieces of wood which had been removed, and show the stains as they were. The accused was found guilty and condemned to penal servitude for life.

face p. 29

Palm-Prints as Evidence of Identity

By DOUGLAS GRANT

Detective-Constable, Finger Print Bureau, Glasgow City Police

MILLIONS of words have been written about the value of finger-prints as a method of establishing identity of the individual. It may seem unnecessary, in an article dealing with palm-prints, to mention finger-prints at all. This is not so, as the identification of palm-prints is established in exactly the same manner as the identification of finger-prints.

It will be observed that papillary ridges cover the entire surface of the palm of the hand, and that these ridges form patterns and disclose characteristics similar to those seen on the finger-tips. Identity is established on the ridge-characteristic data disclosed. When two palm-prints are compared and a sufficient number of ridge-characteristics are found to agree in nature, position, and sequence, the prints are identical. In practice, twenty characteristics in agreement are considered a sufficient number to put the question of identity beyond all reasonable doubt.

Although palm-prints will never supersede finger-prints for identification purposes, they are equally important and, in many cases, indispensable. This is especially so in crimes of the breaking-and-entering class. Frequently cases are taken to Court which rely wholly upon the identification of a portion of the palmar surface.

In his book, *Forensic Medicine*, Professor Sydney Smith says : " Every trace of skin prints, whether of fingers, hand, or foot, should be carefully preserved for future comparison with similar prints from a suspected person." *

Traces of palm-prints will very often be seen at scenes of crime, either alone or accompanying finger-prints. If found alone, then they must be used for identification. Even when found with finger-prints, it does not follow that the imprints

* *Forensic Medicine*, 6th Edition, 1938; page 60.

were made by the same person. Furthermore, we have instances where finger and palmar imprints are found, but, owing to there being insufficient data in the former, the latter are used to prove identity.

The moral to be drawn from this is to take the palm-prints, as well as the finger-prints, of all persons arrested for crimes of breaking and entering, in order that a comparison can be made with the palmar imprints previously filed from scenes of crime. If, by doing so, a number of cases which otherwise would remain unsolved are cleared up, then the taking and filing of palm-prints are as essential as the taking and filing of finger-prints.

Examination at the Scene of a Crime

Assume that a case of breaking and entering has been reported to the police, and that one of the following methods was used to gain entrance to the premises:

Raising lower sash of window and climbing in; lowering upper sash and climbing over; forcing door with jemmy; forcing wooden shutters behind window; cutting through ceiling; cutting through door panel or cutting through wooden partition. In all such cases, palmar imprints will frequently be found at the actual point of entry. At times they may be found a considerable distance from that point owing to the criminal's having to lean or hold on to a wall or some other projection in order to maintain his balance. In others, great pressure has been exerted, and it is often above and to the left or right of jemmy or tool marks that the imprints are found.

When traces thus obtained are only portions of the palm, the officer carrying out the examination will often be able to state which hand made the imprint, simply by imagining for the moment that he is the criminal; or there may be traces of digital marks which would be more conclusive. Such information can be of great assistance to the officers of the Finger Print Bureau, whose duty it is to search and compare these imprints.

Hints on the Taking of Palm-Prints

For taking the impressions it has been found that an appliance of the following description gives the best results:

It consists of a solid block of wood,* measuring 13½ in. by 7½ in. by 3½ in., the upper surface of which is curved. A metal plate is fixed on the left side of the block for taking the inked impression, and the right side is used to record the impression on paper. This appliance can be made at a cost of a few shillings (Fig. 1).

As it frequently happens that the imprints found at scenes of crime disclose only portions of the palm, it is essential, if identifications are to be obtained, that the entire palmar surface be clearly recorded. This can be accomplished only if the following conditions are observed. First, use only sufficient ink to produce a good black-and-white effect without smudging. Secondly, see that the hands of the subject are perfectly clean and free from perspiration.

When taking an impression, first of all hold the subject firmly by the forearm (near to the wrist) with the left hand, at the same time taking the ends of the fingers, which should not be bunched together, in the right hand. Place the palm base first on the inked surface, and allow the hand to lie relaxed. Pressure should then be exerted, especially against the wrist and knuckles, by the operator's placing his hand across the hand being printed. The whole operation is then repeated on the slip, care being taken to prevent the subject from moving his hand while it is in contact with the paper.

After taking the impression, examine each palm and make certain that no loop-formation is disclosed on the ulnar or outer margin. If any doubt exists, a separate impression of this part of the palm should be taken by using an outward, rolling movement, and recording it alongside the main impression. When any other part of the palm fails to yield a clear impression, the part concerned should be recorded separately at the bottom of the slip. This applies especially to the area immediately above the wrist-flexure and to the area at the base of the fingers.

Court Accepts Evidence of Identification

In conclusion, I should like to illustrate the value of palm-prints as evidence of identity by citing a case which

* See illustration facing page 29.

occurred in Glasgow in April 1939. The scene of the crime was a three-apartment dwelling-house situated on the second floor of a tenement building in the east-end of Glasgow. On Saturday, April 1st, 1939, at about 8 p.m., the occupier and his wife, a Mr. and Mrs. McDonald, left their home to do some shopping. At about 8.40 p.m. Mrs. McDonald returned, and, while ascending the stairway, she saw a man, whom she did not know, standing near to her door. Being suspicious of the man, she took particular notice of him. When she approached her door the man hurried downstairs. On inserting the key in the lock she found that it would not operate, and, on hearing sounds coming from inside the house, she at once concluded that the house had been entered. Opening the staircase window, she was in time to see a man drop from her kitchen window on to the roof of an adjoining building and disappear into the courtyard at the rear of the premises. She immediately reported the matter to the police.

Later that evening, while in the street near to her home, she saw the man, whom she had seen on the stairway, standing with several other young men at a street corner. She pointed him out to the police, and he was at once arrested. The accused was well known to the police. The arresting constables remembered seeing him with an associate in the street near to the scene of the crime at about the time the crime was committed, so they arrested the associate also. The latter, by the way, was also well known to the police.

The accused were cautioned and charged, but both denied responsibility, stating that they were in a certain public-house until 10 p.m.

On Sunday, April 2nd, 1939, the house was carefully examined for finger-print evidence, by an officer from the Finger Print Bureau of the Glasgow City Police. It was found that entrance had been gained by climbing a soil-pipe leading from the roof of an adjoining building to the kitchen window. This window had been left unlatched, so that the thief had simply to raise the lower sash and climb in.

No imprints, either digital or palmar, were found at the point of entry. However, before leaving the house unoccupied, it was customary for Mrs. McDonald to lock the door of the

sitting-room, and, to gain entrance to this room, the thief had smashed one of the lower panels of the door. A preliminary examination revealed that an attempt had been made to force the door with a jemmy or similar instrument, Fig. 2—A. When tested for finger-prints, several triangular-shaped traces enclosing skin-ridges were disclosed immediately above the jemmy-marks. It was soon obvious to the finger-print officer, both from the nature and the position of the traces in relation to the jemmy-marks, that they were those of palm-prints surrounded by glove marks, and that they were in all probability made by the person who attempted to force the door by means of the jemmy.

These traces, as indicated by the arrows in Fig. 2, were then photographed, as was the door to show their position thereon. No further evidence, in the nature of finger or palmar imprints, was found in the house, but a pair of leather gloves was recovered from the roof of the building from which entrance had been gained. These, presumably, were thrown away when the thief made his escape.

Up to this time there was little evidence, apart from that of Mrs. McDonald, to connect either of the accused with the crime. Only silver money had been stolen, and that could not be identified. The following day the accused were finger-printed and palm-printed, and when a comparison was made with the imprints from the scene of the crime they were all found to be identical with the left palm-print of the second accused. Both still strongly denied the charge, and challenged the police to prove it.

On May 12th, 1939, the accused appeared for trial in the Sheriff Court at Glasgow, and tendered a plea of not guilty. After a trial lasting several hours, the charge against the first accused was found not proven. The evidence of the positive identification of the palmar imprints on the sitting-room door, however, resulted in the second accused's being found guilty and sent to prison for three months.

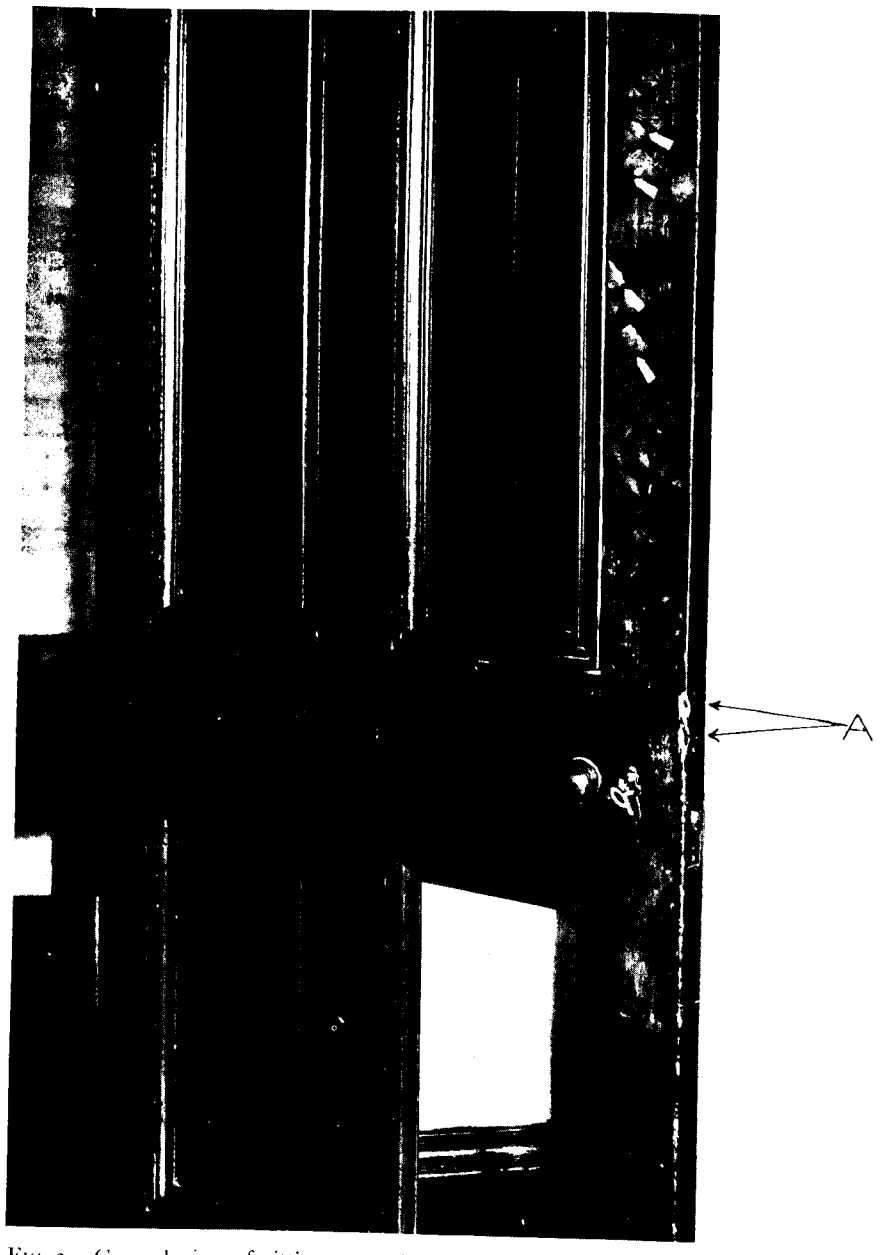

FIG. 2. General view of sitting-room door showing palmar imprints and glove marks as indicated by arrows; jemmy marks at "A" and broken panel.

(*face* p. 34)

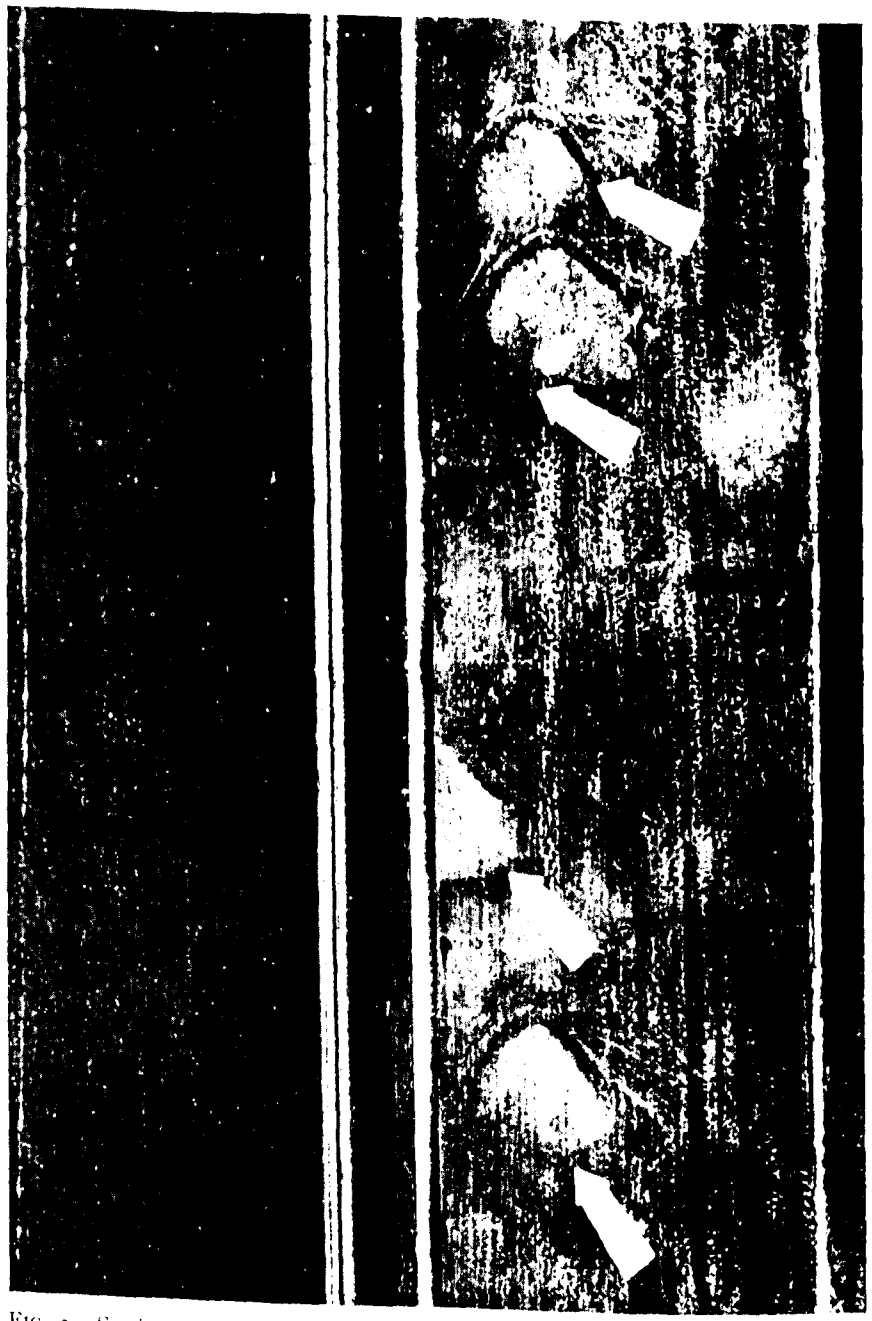

FIG. 3. Section of door showing palmar imprints surmounted by glove marks. The lowermost imprint was used to prove identity.

Police Duty at Air-Raid Incidents

By SERGEANT C. E. TURNER
Wiltshire Constabulary

THE first official indication of the duties which the Police were expected to perform at air raid incidents was set out in *Operation and Training Memorandum No. 4*, issued in May 1940, as follows:

"The Police are responsible for taking charge of the general situation at or near the scene of any raid incident, as regards saving life, protecting property, controlling movements of persons and vehicles on the roads, preventing panic and other uncontrolled movements and maintaining morale."

This generalised statement was followed by a list of specific duties, falling under one or other of the above headings. In the light of practical experience, however, this list was far from comprehensive, and gave little practical indication as to what steps should be taken in an endeavour to achieve or aspire to the abstract ideal.

The successful performance of police duty at all times lies not so much in possessing precise knowledge of what that duty is, but rather in knowing the different ways in which to perform that duty, and in determining which way to select under any given set of circumstances. These ways can only be learned by experience, and the decision as to which should be used must depend on knowledge or instinctive appreciation of the type of person with whom one is called upon to deal, and the frame of mind in which that person happens to be at that particular time.

At air raid incidents the same principle holds good, and while every police officer will at all times be equipped with a certain standard of knowledge and experience of the type of person with whom he is dealing, an important new factor has now appeared, as the frame of mind of the general public immediately after a raid is an unknown quantity to many, and

to those to whom it is unfortunately only too familiar an analytical survey may perhaps prove helpful.

The subject is one which concerns all police officers, for, at an air raid incident, the Police will have Herculean labours to perform—labours which will take considerable time and demand almost unlimited personnel, and labours which to be performed effectively must be performed immediately. The need for personnel will be so great and so urgent that the usual watertight compartments of the Police Service will be temporarily swept away, and all branches will find themselves for a time engaged at air raid incidents on active and exacting duty, by the side of which the importance of their everyday routine work will pale into insignificance.

The saving of life and the protection of property are duties which come instinctively to every police officer, and first aid to the injured is generally their first consideration. After a raid, the scope for the exercise of knowledge and experience in the performance of these two basic duties will be immeasurably greater than it is in normal times, by reason, in the first case, of the omnipresence of apparent or potential dangers, and, in the second, by the collapse of barriers, real or metaphorical, which man has created for the protection of his possessions. This increase, however great it might be, is one not of kind but of degree, and men who have been trained to observe general principles in the little things of life find no novel element in their application when important events come along.

The remainder of police duty at incidents can be split up into two natural divisions—the control of persons, which includes psychological as well as physical control, and the control of traffic. These headings embrace all the new factors which have appeared, together with the new principles which practice has evolved for dealing with them.

The Control of Persons

The noise of a high explosive bomb will no sooner have died away than a powerful suction wave will begin to exert a centripetal* influence on the surrounding district, bringing

* Tending to move towards the centre—in this case the point of explosion.

with it persons who will arrive in large numbers, on foot or in vehicles, stirred by different emotions and with different objects in view.

Broadly speaking, this crowd will consist of three elements. Part of it will be composed of sightseers, pure and simple, generally persons who happen to be passing or living near, and who stop and crowd round in the same way that they do when a street accident occurs. They are not a dangerous element and do not intentionally hinder; but by their passive though stubborn immobility they can present a serious obstacle to all operations, and often a high percentage of available personnel is required to shepherd them. Though often critical, they are seldom hostile or resentful; but they may provide material to feed the fires of panic when some other element in the crowd has ignited them.

The second component is a far more novel and dangerous one. Suppose for a moment that bombs have dropped in X Street, a typical street in a typical town, causing slight damage and a few casualties. Rumour will quickly spread, enlarging upon the extent of the damage and at the same time colouring the story with imaginative details and additions, dangerous by their vague uncertainty. Soon the whole town will be ringing with stories to the effect that that part of the town in which X Street is situated has been seriously damaged. Now, in all parts there will be a large number of people with friends and relatives living near X Street, husbands working near X Street and children going to school near X Street. These persons will be anxious to find out whether their relatives have been injured; even if that is not the case, they will probably wish to visit them, console them and allay their panic, with the result that a large number of persons will at the same time be flocking towards the affected district.

In a large town, this movement will provide transport and traffic problems of varying magnitude. When these persons arrive, they will be far more persistent than the sightseers, and will be in anxious quest of information. The first person they will approach will be the policeman, and the number of enquiries addressed to the Police at these times has in practice been enormous.

At large incidents, it will often have been necessary hurriedly to evacuate a large number of houses for some reason or other, and when the friends and relatives of the evacuated persons arrive, they will be further distressed at being unable to find these persons at their home, and enquiries as to their whereabouts will become increasingly persistent. In the event of damage to or evacuation of a cinema, school, shelter or other building where many persons are generally to be found, this problem will be even more acute.

A certain number of these people will eventually find that close friends or relatives have been killed, and sudden bereavement will generally result in grief, dejection or collapse; but sometimes it will produce a terrified and frenzied state of mind which will only too rapidly spread to others. Whatever may be the reaction to loss of or injury to loved ones, it is seldom philosophical, and the victim is always in urgent need of comfort or assistance.

The best method of dealing with this section of the crowd, and preventing them from hindering the work which is going on, seems to be to endeavour to keep them as far away from the incident as possible. To this end the establishment of an enquiry bureau, not too close to the scene of the damage, has been found useful and necessary in the larger towns. All enquiries regarding the whereabouts of persons who cannot be found can be directed to that particular place. Persons evacuated can leave the address to which they will be going at this bureau, and those making subsequent enquiries can accordingly be furnished with information. Although this seems to be a task more for the local authorities than for the Police, co-operation by the Police in any premeditated schemes is desirable.

In large towns and cities, the rapid circulation of information regarding casualties to outlying police stations has proved beneficial, as in many cases persons will be prevented from flocking to the incident itself if they realise that casualty lists are posted in their local police stations shortly after the occurrence.

A third ingredient of the crowd will be the involuntary one of persons hurriedly evacuated. For example, a fairly

large family may be turned out of their house owing to the vicinity of an unexploded bomb. The head of the family may be in search of local accommodation for his family, rather than take advantage of any Public Assistance scheme. The remainder of the family will be left in the street, possibly in inclement weather conditions, unless temporary accommodation can be found for them. The establishment of enquiry bureaux as outlined above would materially assist in dealing with this section of the community.

If national or even only local advice could be given to each householder that he should immediately select one, or better still two, places where his family could be received at short notice, and to make mutual arrangements with friends, who did not live too close to him, to give emergency accommodation to each other, much time and trouble would be saved if ever the occasion arose.

Schemes for dealing with persons rendered homeless, or temporarily homeless, have, of course, been prepared by most of the responsible authorities; but in most cases people prefer to stay with their friends, and this practice should be encouraged, thereby throwing less strain on the authorities. Difficulty has been experienced when streets in the poorer quarters of towns have been evacuated, as the poor have fewer friends and fewer people willing to receive them. Elsewhere hospitality shown by the community to their neighbours in distress has been conspicuous, and even where whole streets have been evacuated, the occupants have found alternative accommodation in a very short space of time.

The proportion in which these three main elements will be present in any crowd will vary considerably according to times and circumstances. By reducing as far as possible the numbers, and keeping them back from the site of the damage, operations will be facilitated, and uncontrolled movements will generally be rendered less likely. At all events, the congregation of a large number of people in one place should be discouraged, as it affords a target for hostile aircraft, and numerous cases have occurred where two or more salvos of bombs have been dropped, at intervals of several hours, in exactly the same place. If a crowd had been allowed to collect

after the first occasion, damage on the second might have been very much more serious.

Practice has shown that while only a small percentage of persons volunteer for the Civil Defence Service, a large number of untrained persons are willing and anxious to help when the damage occurs. Such assistance is generally of far more harm than good, since the handling of casualties is a task only for trained persons, and for the untrained to attempt rescue and first aid work usually results in aggravation of the injury. To restrain well-meaning persons who want to help demands the release of personnel, and their duty is neither enviable nor easy; but if the energy of these people can be directed into other channels, and unskilled jobs can be found for them such as the running of errands, two birds will be killed with one stone.

Hysteria and Fright

Even with a small crowd of onlookers, although the danger from uncontrolled movements is not so great as it would be with a large crowd, the necessity to maintain morale is still important. To realise how to deal with any incipient movements, and nip panic in the bud, it might be advantageous to examine the various causes of panic which are present at any raid incident, and the various steps which can be taken to avoid or deal with them.

The mere fact that a raid is in progress has occasionally upset the mental balance of certain persons, causing them to run screaming through the streets. Cases of this kind are exceptional, but terror on the part of one person, when that person so obviously gives rein to it, will rapidly result in loss of morale over a wide area. To those who are terrified by the noise the wearing of earplugs has proved helpful, while the placing of rubber or some similar substance between the teeth has proved most beneficial in preventing injury to the ear-drums.

Another cause is undoubtedly the tendency of the individual to spread gruesome stories of what he has seen and heard, and at the same time to exaggerate grossly. The average person seems to delight in this, and often tells fantastic stories of damage or injury, even spreading rumours of damage

where none has occurred. This tendency has shown itself to be far more prevalent than most people without experience are willing to believe. Persons who do this should be warned that they are assisting the enemy, and if they realise that someone is taking steps to write down what they are saying, they will in future be more guarded in their remarks.

The sight of injured persons, too, or of dead or mutilated bodies, will have serious effects on the morale of those who happened to see them. While the problem of dealing with the injured will no doubt be satisfactorily handled at an early stage, the problem of dealing with the dead bodies will generally be left in the first instance to the Police. The tendency has been to regard the covering of the dead as one of the less important duties, and subsidiary to that of attending to the injured; but the presence of dead bodies may not only produce panic among the uninjured, but has its effects on the injured persons lying close to the remains of their former friends in producing secondary shock, which in some cases has proved more serious than delay in attending to their injuries, and which may well prove fatal. In practice, the dead should be covered at an early stage, and it is often advisable to remove them to a nearby building or room which would serve as a temporary mortuary, and where they would be in a position where bystanders could not approach them. In this connection, it has proved helpful for the Police to label the dead bodies before their removal to a mortuary, as this greatly facilitates identification problems later.

Another possible cause of panic lies in the late arrival of assistance, and in large towns and cities all conceivable steps have been taken to prevent this. The question of the despatch of the Civil Defence Services is not one for the Police; but the sending for the services, the first aid and rescue work pending their arrival, and the deployment of those services when they arrive, frequently is, and some practical hints can be given under each of these various headings.

At the Scene of the Incident

Before the saving of life is even attempted, it is the duty of the Police to report the incident and ask for aid, if this has

not already been done. Cases have occurred where the instinctive desire to save life has resulted in considerable delay in asking for Civil Defence Services to be despatched. In warfare, particularly, the duty towards the community must come before duty towards the individual. To attend to one injured person before calling for aid might mean delay in bringing help for twenty or more others, and although the practice may seem callous, it must obviously be observed. A policeman on traffic duty, clearing the way for the arrival of the services, may be doing his duty to the community better than his colleague who is trying to save the life of one man.

Although the Wardens' Service was founded largely for the purpose of reporting incidents, it is a remarkable fact that where actual incidents have taken place, generally at least half, and sometimes nearly all, the reports have in the first instance come from the Police. This fact has emerged in rural and urban districts alike, and has been explained by many circumstances, the details of which do not lie within the scope of this article.

When aid is available, whether from the wardens, first aid parties, or any other source, it is essential that this aid should as far as possible be evenly distributed. For example, take the case of three buildings where casualties have been caused, ten at one building and three at each of the other two. Even though help, when it arrives, may be inadequate to deal with the situation as a whole, it is better to send a little assistance to each place than to deal adequately with one scene of damage at the expense of the other two. People are very quick to notice when this has been done, and are very prone to misinterpret any action on the part of officials which might suggest that favour is being shown to one person at the expense of another.

On arrival at the scene of the damage the Police may be informed of the presence of casualties; but having attended to these they should on no account assume that the obvious casualties are the only ones present. In some dwellings, perhaps, the occupants may have been injured by flying glass or fragments, and may have no means of communicating the fact to the outside world. In many cases there may be only one

occupant of a house, and that one an aged person who may have received injuries which would prove fatal unless they received prompt attention. Police and wardens have been compelled, in the face of this possibility, to make house-to-house calls in the vicinity of damaged premises, to ascertain whether any injuries have been caused, or whether they can be of any assistance; often people have been lying seriously injured in a house several hundred yards from where a bomb has fallen, and much useful work has been performed and many lives saved by persons who have been detailed to make such enquiries. In some districts householders have been supplied with cards bearing words to indicate whether they are or are not in need of assistance, with instructions to exhibit them in their window after a raid has taken place, and the result has been to lessen appreciably the number of calls it is necessary for the Police or wardens to make.

When assistance has been thus deployed, attention should be paid to the manner in which it is carried out. Cases have arisen where, for example, persons or bodies have been buried and it has been known that there is no possible hope of being able to reach them. Maybe work in the darkness is not practicable and proves of little avail owing to the restricted lighting, or to the fact that the public, when a raid is still in progress, forcibly extinguish lights under the impression that those lights can be seen by the enemy. Under such circumstances, although it is futile to carry on, it is better to make some pretence of doing so, even if the sum total of one's achievement is the moving of a small pile of debris, the practical advantage of which is negligible. This will have the effect of pacifying the bystanders, many of whom may be close relatives of the trapped or injured, and make them feel that literally no stone is being left unturned in the endeavour to effect rescue. Even the presence of an ambulance parked near by will make a good deal of difference, and will show the anxious onlookers that hope has not finally been given up.

In their dealings with the crowd the Police have found an invaluable ally in the shape of loud-speaker installations on police vehicles. The effective use of these, in addition to being of great assistance in communicating information over a wide

area in a small space of time, has played an important part in maintaining public morale at its high level. Not only does the use of such units simplify the shepherding of the people, but it gives them the impression that something is being done for them by the authorities. Many are in immediate need of shelter, food and warmth, and to inform them at once where these needs can be satisfied has the effect of heartening and consoling them and impressing upon them that they are not forgotten.

The Control of Traffic

The best way to approach the traffic problem is to examine the various types of traffic with which the Police will have to deal, and these fall into four classes:

(*a*) Through traffic, or vehicles, the drivers of which want to proceed on their journey with a minimum of delay.

(*b*) Vehicles carrying sightseers, or vehicles passing by, the drivers of which want to stop and see what has happened.

(*c*) Civil Defence Service traffic and staff cars.

(*d*) Vehicles stationary and immobilised before the raid, near the scene of the incident, and still there.

On their arrival the Police will be greatly handicapped in many cases by the presence of broken glass on the roads. When high explosive bombs fall near shopping centres where there is normally a good deal of plate glass, broken glass is scattered in the street to such an extent that it is almost impossible for vehicles to be driven over it without having their tyres cut and becoming immobilised. Bystanders can be called upon to help clear it up, if brooms are available, and some Civil Defence Service vehicles carry brooms for this purpose. A snow-plough may be of use in bad cases. If, however, the driver of a vehicle is compelled to take the risk of driving over it, a speed of about 15 miles an hour is advised, as at that speed the risk is at its lowest.

Through Traffic. A complete diversion of through traffic is advisable, so that the vehicles and the Civil Defence Service traffic do not cause mutual hindrance and obstruction. A detour of several miles is generally considered preferable to permitting ordinary traffic to approach too closely. The

problem of effecting a convenient detour can be solved without much difficulty in towns, owing to the layout of the streets and the numerical strength and proximity of personnel available. To the rural constable the problem is far more acute. If a main road is blocked by damage, he is called upon to deal with almost as heavy a volume of traffic as there would be in a town. He is not often able to divert it readily and he has, in many cases, little man-power available for the purpose. Very soon he is faced by a congestion of alarming proportions.

So great is the anxiety of some police officers with actual experience to keep through traffic away from the scene of operations, owing partly to the actual or probable presence of unexploded bombs, that even where roads have not been blocked by damage they would block all road approaches and, if local diversion is not possible, continue to turn back traffic or keep it waiting. The agglomeration of vehicles is to be avoided if possible, owing to the fact that they present a target for the enemy. Of these two evils, the Police have often been called upon to determine the lesser, and circumstances can be the only guide as to which course to adopt.

To establish a diversion, and at the same time to see that no unnecessary obstruction is caused, is a task which may make a serious drain on personnel. Many men can often be released from duty of this kind by the discriminate use of road barriers, with red lamps at night, or in daytime even by the use of rope.

Traffic bringing Sightseers. While the drivers of many vehicles through the district where damage has occurred will be unwilling to stop, a large proportion will be incited by curiosity to delay their journey and see what has happened. They will drive their vehicle as near to the damage as they are allowed, then leave it and proceed on foot. Their stationary vehicle will at once cause obstruction. If the diversion is a long one, and they realise that to approach closely they will have to make a considerable journey on foot, they will often think it not worth their while, and continue their journey, thereby lessening the traffic problems of the Police. The farther away such traffic is kept, the better for all.

In addition, a large number of vehicles will arrive, bringing persons who have made a special journey either out of

curiosity or with some definite purpose in view, such as to enquire after friends, or to examine property that may have been damaged. These vehicles will naturally be stopped at the point where through traffic is being diverted, and if that point is near a car park or waste ground, then such vehicles can be driven off the road to a place where they will not cause obstruction. Sometimes three men are needed at one point for this duty, as the drivers are so persistent in their endeavours to slip past; but if an artificial barrier is erected, one will generally suffice, or in some cases none at all.

That sightseers will deliberately make a special journey to view air raid damage, time and again, in these days of petrol rationing, seems incredible; but it is none the less true. Large numbers of people arrive within half an hour of the bombs being dropped, even in rural out-of-the-way places and even during the hours of darkness, and they continue to arrive several days afterwards, when the hindrance they cause will not be so severe; but the trouble and inconvenience they cause the local Police will be considerable. The novelty shows no signs of wearing off, and the appetite of the general public for this kind of thing does not appear to have been satiated yet. In one instance, where a German aeroplane crashed in open country, nearly eight thousand people actually paid to see it, and at one time over two hundred cars were parked near by. On another occasion a large number of people made a long pilgrimage to see an unexploded bomb!

Civil Defence Service Traffic. The disposition of Civil Defence Service vehicles near the scene of damage is a problem needing a little technical knowledge about each of the services, and one about which police officers ought to know something. Fire Brigade vehicles must at all times be given priority, plenty of space being left for them near the scene of the fire, and access to all available water supplies; reliance cannot be placed on water mains alone, as these have so often been damaged. Rescue Party vehicles, laden with hydraulic jacks and other heavy gear, should have second priority and should be allowed to approach closely to the scene of operations. The vehicles of other services should usually be parked well away from the scene of the damage, in suitable side streets or on waste land.

Ambulances can be allowed to approach the scene, but only for loading, and not more than two at a time. They should be made to keep well away from hydrants, and space should be left at the rear of each to facilitate loading. Care should be taken to see that loaded ambulances should not be driven over rough ground, or even hose ramps, and where a road is blocked, an ambulance should, where possible, be parked on each side of the block.

Where high explosive bombs have fallen near buildings, fire may not break out immediately; but there is always a danger that it may do so later on, even as long as twenty-four hours later. It is interesting to note that fires have often broken out some distance away from where any bomb has dropped, these being due in some cases to the projection of red-hot shrapnel through a window on to some inflammable material, and in others to the blast or suction scattering red-hot embers from a fire grate about an unoccupied room, the embers falling on chairs or carpets, smouldering for a long time, then suddenly bursting into flame. As such fires sometimes do not become apparent for many hours it is essential at all times to see that hydrants are never obstructed.

Vehicles should be made to park clear of damaged walls, and not down-wind of smoke. They should be left in such a position that they can be moved or driven away with a minimum of delay; if wheels are locked outwards and space left to avoid reversing, and if they are parked facing the direction in which they will next proceed, and the driver made to stand by, this will be made possible. Vehicles are generally better kept on one side of the road only, and space should be left, where possible, for any additions which may subsequently be needed.

To park a number of vehicles together in one place is often a temptation and an easy way out, if a suitable place is at hand such as a square, car park or waste ground. To do so is to run the risk of having all vehicles damaged if further bombs are dropped near by; but it may be necessary, and if the vehicles are only there for a short time, the risk is accordingly lessened. The possibility of a delayed-action bomb having been dropped with others brings out still further the need for staggering vehicles rather than grouping them.

Staff cars should always be kept as far away from the scene of damage as practicable, and active steps are necessary to make sure that this is done, and that instructions are obeyed.

A fact frequently forgotten when considering traffic at air raid incidents, until actual experience has made the need apparent, is that after a raid a large number of cars and ambulances will be converging on the hospital or first aid post at the same time. Serious congestion may be caused there, resulting in delay in the unloading of casualties. The smooth flow of traffic at the incident will be more than neutralised if this is allowed to take place, and a little foresight in this respect will fully justify the time and personnel required to deal with the problem.

Stationary Vehicles. At any given time of the day there are always a number of stationary vehicles parked in every district, some in dangerous positions or in positions where they would cause obstruction if allowed to remain. The moment immediately after an air raid is no exception. Drivers may be on business, sheltering or perhaps injured, and if left alone they would not move their vehicles for a considerable time. Police are often compelled to clear the whole area at once, in order to allow unobstructed passage and parking room for the Civil Defence Service vehicles when they arrive, and this is where the compulsory immobilisation of vehicles is apt to prove a mixed blessing, since the drivers have to be found before the vehicles can be moved at all.

Conclusion

No mention has been made of how the use of poison gas in aerial warfare would affect the situation, because no practical experience can be given, neither is it profitable to conjecture how its use would increase or decrease the difficulties of the Police, since the methods in which it can be used vary so diversely. In any case results would never be altogether on the lines anticipated, however logical the reasoning for any particular case might be.

Experience has shown, however, that amid the horrors of war the British people has turned for aid and guidance to the Police far more so than in peace time. To many, the Police

Force has come to represent one of the few factors in everyday life that has undergone little outward change, a symbol of stability and a sheet anchor to which is moored the confidence of local citizens. Police have proved themselves capable not only of facing hard work and long hours in a spirit of cheerful determination, but also of adapting themselves readily to the many and dangerous duties for which they have no precedent and little guidance except common sense, and of grappling with problems which have at times assumed almost unmanageable proportions.

While applause is rained upon other Civil Defence Services, many of them functioning for the first time, there is no need for the Police to feel that they have not deserved special mention. Public opinion has paid them the highest tribute it can—it has taken their sterling contribution for granted.

The Effects of Heat on the Histological Structure of Bone

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Introduction

As attempts are sometimes made to conceal a crime by burning human remains it may happen that a few charred specimens are all that the medico-legal expert may have to work on. It may not even be obvious that the specimens produced are indeed bone, far less human bone, as all the osseous landmarks may have been destroyed by exposure to flame. This is particularly the case when the remains have been those of a fœtus or young child.

About two years ago a garden hut was burned down and no reason was apparent for the outbreak of the fire. Some weeks later, when the owner was clearing away the debris, he found amongst the ashes what he thought looked like the remains of a child's foot enclosed in a charred boot. This specimen appeared on naked-eye examination like the lower ends of the tibia and fibula and the bones of the tarsus, all fused on to the sole of a heavy boot. A radiological examination was carried out and the radiologist expressed the opinion that the X-ray appearances approximated closely to those of bone. Sections of the material were ground and compared with pieces of human bone that had been charred to a similar degree. The similarity was so striking as to lead an expert anatomist to express the opinion that the specimen was almost certainly bone. Ultimately, as a result of chemical analysis, it was proved that the material did not contain the requisite proportions of mineral salts and therefore could not be bone.

As it had proved so difficult in this particular case to identify the material it seemed to me that it would be worth while to investigate the effects of heat on the histological structure of bone.

Before a direct attack could be made on the problem it was necessary to establish standards with normal human bone. A survey of the literature on the histology of bone revealed the fact that there appeared to be no standard recognised method which is generally accepted as suitable for all purposes, or even a combination of fixative, decalcifying agent, and stain which, it is generally agreed, gives a satisfactory picture of the general structure of this tissue. Each individual worker expresses his preference for one particular technique, and in order to establish a method suitable for general medico-legal work I tested out a number of methods that had been recommended by previous workers.

Fixatives

Formalin and 10 per cent. neutral aqueous formaldehyde are recommended by most histologists, and these fixatives, as well as 90 per cent. alcohol, which is advocated by Gooding and Stewart, were tried in combination with a variety of decalcifying fluids. When the bone was decalcified in equal parts of 85 per cent. aqueous formic acid and 20 per cent. sodium citrate as recommended by Evans and Krajian a marked difference was apparent, depending on which fixative was used. If 10 per cent. formaldehyde was employed the decalcification took very much longer than if the tissue was fixed in 90 per cent. alcohol. On an average the process was accomplished twice as quickly when fixation in 90 per cent. alcohol was used. In one instance with specimens of the same dimensions spongy bone decalcified in seven days after fixation in spirit and twenty-two days after treatment with 10 per cent. formaldehyde. Corresponding pieces of compact bone required twenty-two and forty-nine days respectively. However, after the use of 90 per cent. alcohol for fixation, the microscopic structure is not nearly so well shown. With all the other decalcifying agents used the fixative seemed to make little if any difference to the result, either as regards the time

taken for the process of decalcification or to the histological picture.

Decalcifying Fluids

For medico-legal work it is desirable that reasonable speed compatible with accuracy should be possible in carrying out an investigation. Police authorities do not like to have to wait several months for an answer to a problem if delay can be avoided. Consequently I wished to find a fairly rapid technique which at the same time would yield consistently accurate results. The blocks used in this investigation were all about one centimetre cube in size and the decalcifying fluids were changed every forty-eight hours to ensure as lively an action as possible.

Five per cent. Nitric Acid in 90 per cent. Alcohol.—This is recommended as a method of choice by Gooding and Stewart, but I did not find it satisfactory. It is not a particularly rapid process, a small fragment of cancellous bone taking eight days to decalcify and blocks one centimetre cube requiring twelve days. Similar pieces of femur took four weeks. This process makes the bone sticky and gelatinous, and while the surface layers soften rapidly a hard kernel remains, and, because of the presence of the sticky surface layer, permeation by the fluid is very slow and the central kernel takes a long time to soften. In addition the histological appearances are poor no matter how the sections are stained. The laminated structure of the bone is hazy and indistinct, due to swelling of the collagenous fibres, and the cellular elements are poorly demonstrated.

Muller's Fluid with 1 per cent. Nitric Acid.—This generally proved to be a satisfactory reagent. It is particularly suitable for spongy bone, and while not specially suitable for compact bone it can still be used for this tissue. Pieces of cancellous bone with cortex about 1 cm. cube took from eight to fifteen days to prepare, but in a week pure cancellous bone is quite decalcified. Portions of adult compact bone of the same size required from twenty-six to thirty-six days in the fluid. It was found that pieces of os calcis treated by this method, dehydrated in "Dioxan," and embedded in paraffin wax,

(All illustrations magnified 280 times)

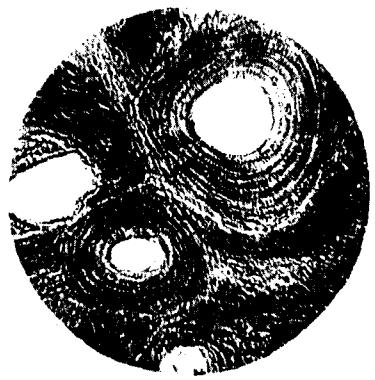

Fig. 1. Normal bone.

Fig. 2. Burned compact bone showing increased prominence of canaliculi and commencing distortion of lacunæ.

Fig. 3. Burned compact bone showing granularity of lamellæ, disappearance and distortion of lacunæ, and fading of Haversian lamellæ.

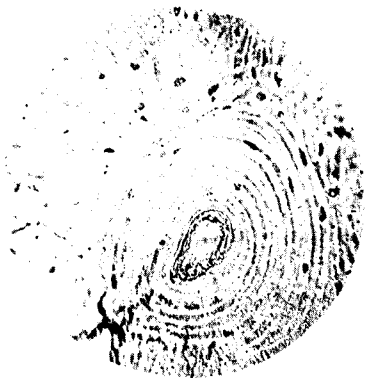

Fig. 4. Haversian lamellæ becoming increasingly indistinct. Small numbers of lacunæ in evidence.

(*face* p. 52)

(All illustrations magnified 280 times)

FIG. 5. Features seen in previous illustrations and in addition fissures in inter-Haversian bone.

FIG. 6. Almost all trace of Haversian lamellæ gone. Shadowy outlines of distorted lacunæ present in places. Haversian canal with portions of central lamellæ cast off into lumen.

FIG. 7. Haversian canals almost filled with granular debris.

FIG. 8. Granular matrix showing no landmarks except a few faintly visible distorted lacunæ.

behaved very well, did not become unduly hard during dehydration, cut easily, and produced good histological specimens. Jaffe agrees that Muller's fluid alone or with the addition of nitric acid gives the best result for general diagnostic purposes. Muller's fluid without the addition of nitric acid is suitable for spongy bone, but decalcification takes many weeks and the addition of the acid does not prejudice the end result. This method is also suitable for use on fœtal bone, and the structure of the bone is as clearly shown as by any other method. Because of the relative rapidity of decalcification, the ease with which the tissue can be dealt with thereafter, and the excellent structural details seen in the sections, I consider that for general work this is easily the best method for use on cancellous bone with a thin cortex.

Ten per cent. Hydrochloric Acid in Water.—This is a very drastic decalcifying agent. Spongy bone is prepared in forty-eight to seventy-two hours or less, while compact bone is ready to deal with in about a week. This method, however, spoils the histological picture and is unreliable for detailed study. This method could be used for compact bone if a very rapid result is desired; but lower dilutions are recommended. It is not suitable for cancellous bone.

The Method of Evans and Krajian.—These workers recommend fixation in 10 per cent. formaldehyde or any standard fixative, followed by decalcification in equal parts of 85 per cent. aqueous formic acid and 20 per cent. aqueous sodium citrate. As far as speed in decalcification is concerned I found that used in conjunction with 90 per cent. alcohol as a fixative the results were much more rapid. After fixation in 90 per cent. alcohol softening is achieved in about seven days in the case of spongy bone and sixteen to twenty-two days for cortical bone. However, the element of speed is paid for in the shape of inferior sections. There is no doubt that the use of formaldehyde is very much superior to the use of alcohol in conjunction with this particular decalcifying fluid. On the whole this is a satisfactory technique, particularly for compact bone, but I do not regard it as a method of choice for either type of bone as far as general histology is concerned.

Five per cent. Nitric Acid in Water.—For compact bone

Jaffe recommends this reagent. After treatment the block is washed in 5 per cent. lithium or sodium sulphate for twenty-four hours, changing the solution several times till it is neutral to litmus. The tissue is then washed in running water for forty-eight hours. Cancellous bone is decalcified in from four to seven days, and compact bone blocks are prepared in from six to nine days. This is a rapid method and for ordinary structural details I consider this the best technique as far as cortical bone is concerned. It can be used to decalcify cancellous bone, but this tissue requires less drastic treatment to obtain the best results.

Thirty per cent. Formic Acid in 5 per cent. Formaldehyde.—This reagent has been recommended by Gooding and Stewart, standing equal in favour with a 5 per cent. solution of nitric acid in 90 per cent. alcohol. For general purposes it is a useful fluid.

Saturated Sulphurous Acid.—As a decalcifier this solution is not particularly good. It softened blocks of spongy bone of the usual size in about a week, but took fifty to sixty days to deal with compact bone. The results were passable but did not compare with those obtained by the use of Muller's fluid, nitric acid in water, or the solution of Evans and Krajian.

Washing

After decalcification has been completed as estimated, by needling the specimen or if possible by X-ray examination, the decalcifying agent must be thoroughly washed from the blocks under running water for twenty-four hours at least before further treatment. After the use of nitric acid in water the blocks should be placed in a 5 per cent. solution of lithium of sodium sulphate for twenty-four hours, changing the fluid frequently till it is neutral in reaction. Thereafter the tissue is washed in running water for forty-eight hours. Complete elimination of the decalcifying agent is essential before further treatment.

Dehydration, Clearing, Embedding, and Cutting

Blocks of spongy bone are best dealt with by the paraffin method, as when cut with a freezing microtome the sections

crumble and are fragmentary and unsatisfactory. Dehydration of the decalcified blocks is a difficult problem as in the alcohols the tissue readily becomes hard, and by the time embedding is completed the block is too hard for sectioning. For dehydration the use of diethylene dioxide (Dioxan) has proved a useful alternative to alcohol. This fluid is mixable equally with water or paraffin wax, and when the block is dehydrated with this medium embedding is satisfactory. The use of " Dioxan " prevents hardening of the tissue. The washed blocks are placed in the " Dioxan " and the fluid changed twice at intervals of two hours. Paraffin wax is then added to fresh " Dioxan " and left over the oven for about twenty hours. Treatment depends of course on the size of the blocks, and the above times apply to blocks of about 1 cm. cube. This reagent has two disadvantages. First, it is a highly toxic substance and requires great care in its use, and secondly, the sections show some tendency to leave the slides during staining processes. Dehydration with alcohol and clearing in cedar-wood oil is quite satisfactory if undue hardening of the tissue can be avoided. Cedar-wood oil is preferable to xylol as a clearing agent, as the latter also tends to make adhesion of the sections to the slide faulty even though the latter are albuminised. There is no improvement in the histological picture with the use of " Dioxan " as compared with spirit.

Cancellous bone blocks dehydrated in " Dioxan " require about thirty hours' impregnation in paraffin wax. Compact bone can best be cut by the freezing method, and in all cases sections of bone should be cut at 15 to 20 μ thick.

Mounting and Staining

Numerous staining methods were tried out on tissue treated in the various ways detailed above. The stains used were Carmine, Orange-G, Van Gieson's stain, Neutral Red, Haemalum and Eosin, Mann's Methylene Blue and Eosin, Mallory's stain, and the Gallein method with Phosphotungstic Acid. As a result of numerous experiments there is no doubt that for the purposes of general histological study sections stained in Orange-G and mounted in glycerin jelly, and those stained with Gallein and Phosphotungstic Acid, produce the

best results. Of course Orange-G is a watery stain, and as no differential staining is produced the cellular elements cannot be subjected to detailed examination. However, all the architectural features of the bone are very clearly shown. When using watery stains and mounting in glycerin jelly there tends to be some diffusion of the stain into the mounting medium. This defect can to a very large extent be overcome by thoroughly washing the stained sections in water so that the surplus stain is removed and the sections become quite pale. In addition, and more important still, diffusion is further minimised and the histological picture greatly improved by allowing the section to dry on the slide or on fine blotting paper before the mounting medium is applied. This allows the Haversian canals, lacunæ, and canaliculi to fill with air, thus making them stand out clearly. With the passage of time the appearances, unfortunately, gradually deteriorate. This method is equally suitable for cancellous or compact bone.

The Gallein method as described by Petersen is also a particularly good one and is specially suitable for compact bone. It has the advantage that the cellular elements are clearly shown against the surrounding matrix.

All the other stains used were found to produce vastly inferior results, though an occasional good specimen was obtained. None was so consistently satisfactory as the techniques detailed above.

Conclusions

As a result of my experiments I have come to the conclusion that for a study of the general architecture of bone the following technique should be adopted.

Cancellous Bone.—Fix in 10 per cent. aqueous neutral formaldehyde for forty-eight hours.

Decalcify in Muller's fluid plus 1 per cent. nitric acid.

Wash in running water for twenty-four hours.

Dehydrate in " Dioxan " as above.

Impregnate and embed in paraffin wax.

Stain with Orange-G and mount in glycerin jelly or stain with Gallein and Phosphotungstic Acid and mount in canada balsam.

Compact Bone.—Fix in 10 per cent. aqueous neutral formaldehyde.

Decalcify in 5 per cent. nitric acid in water.

Wash in 5 per cent. sodium sulphate.

Wash in running water for forty-eight hours.

Cut with freezing microtome.

Stain with Orange-G and mount in glycerin jelly or stain with Gallein and Phosphotungstic Acid and mount in canada balsam.

From the purely practical point of view it has been repeatedly found that tissue decalcified in Muller's fluid with nitric acid and dehydrated in " Dioxan " is much easier to handle than when any other technique is used. In addition the details of structure are more clearly and consistently demonstrated. As far as compact bone is concerned I prefer fixation in 10 per cent. formaldehyde and decalcification in a watery solution of 5 per cent. nitric acid. Muller's fluid with nitric acid is slow but produces satisfactory results, and the third in order of preference is the method of Evans and Krajian.

The Effects of Heat on the Histology of Bone

Technique.—It was very difficult to establish times and temperatures for the various structural changes found, but in any case from the practical point of view this is of no consequence. Portions of adult bone were exposed to the action of a Bunsen flame for times varying from twenty-five seconds to ten minutes. It was found that compact bone after exposure to the flame for three minutes could not be decalcified and simply disintegrated in the acid. By this time the bone was extensively charred and could only be prepared by grinding. When the charring is severe even this process does not yield identifiable preparations, as the bone has become absolutely structureless long before complete charring is achieved. The compact bone specimens were decalcified in nitric acid and cut with the freezing microtome. Sections were stained with Orange-G and Gallein and Phosphotungstic Acid. Decalcification is very rapid after exposure to heat, and specimens 1 cm. cube burnt for one minute were quite soft after three

days' exposure to the action of 5 per cent. nitric acid. Cancellous bone is of course much more readily charred than compact bone, and this type of material was too severely burnt for successful decalcification after two minutes in the flame. The spongy bone was prepared according to the method detailed above.

Structural Changes

Compact Bone.—The first effect of exposure to heat is a great increase in prominence of the canaliculi in the bone (Fig. 2). This is probably the earliest phase in the disruption of the lamellar structure. Following this appearance the lamellæ become coarsely granular in structure and the lacunæ begin to disappear (Fig. 3). With the increase in granularity of the lamellæ the canaliculi disappear altogether. The obliteration of the lacunæ occurs in stages. They may appear distorted and flattened or of normal size but filled with granular debris similar to that seen where the lamellæ have disintegrated. The lacunæ are ultimately seen as hazy shadowy outlines barely discernible in a uniformly granular matrix (Fig. 8). Meanwhile the lamellar formation in the Haversian systems gradually disappears till no sign of this feature is left at all.

At this stage the matrix is shown simply as a uniformly flat finely granular structureless mass with a few indistinct scattered lacunæ here and there.

We are now left with an almost unidentifiable picture. At the same time as the lamellæ are being disrupted the periphery of the Haversian canals is becoming ragged and ill-defined (Fig. 6). This ragged appearance is due to the gradual flaking off of small fragments of the central bone, and this debris, being washed out in preparation for the most part, results in an appreciable increase in the size of the canal and a corresponding diminution in the diameter of the system. The increase in size of the canals is of course small. In some cases the debris completely chokes the Haversian canals (Fig. 7), and as this material is of the same structure as the matrix surrounding them, when the canals become filled with those fragments of lamellæ they become indistinguishable from the surrounding bone and therefore invisible.

By this time we are left with a granular structureless matrix perforated here and there by Haversian canals, the details of the corresponding systems having vanished. Of course an appearance like this could not prove sufficient for purposes of positive identification. While these changes are taking place cracks appear in the inter-Haversian bone (Fig. 5). These cracks are irregular in width and direction and often run from a similar fissure at the periphery of an Haversian system to another crack in a different part of the section. It is difficult to be certain whether these fissures are entirely due to the action of heat.

It will be appreciated from the above that before bone has reached the stage that it can no longer be successfully decalcified it has become unidentifiable histologically. This was confirmed by preparing ground discs of charred bone. When bone has been charred it is much more friable than normal unburnt bone, and consequently the preparation of ground discs suitable for microscopic study is a very difficult process. These preparations present a uniformly granular appearance without any identifiable features except an occasional Haversian canal. Most of the canals are no doubt rendered invisible by being clogged with charred debris. It follows therefore that when compact bone has been severely burnt the only method of identification of the material, if small fragments only are available for examination, and no portion of bone is left which as a whole can be identified by its anatomical features, is to subject the remains to chemical analysis. It will of course be obvious that when visual identification of microscopic preparations is possible this is very much more valuable than having to rely on an analysis which of course can only prove that the material under test contains mineral constituents in the same proportions as one normally finds in bone.

Cancellous Bone.—As cancellous bone normally has far less to show in the shape of identifiable architectural features than compact bone the corresponding changes due to heat are consequently much less definite. Furthermore the tissue is more easily rendered unidentifiable. As in the case of the compact bone the first major change in structure is the

appearance of coarse granularity in the lamellæ. In some preparations the lacunæ and canaliculi are very distinctly seen after mild burning. The lamellar structure gradually disintegrates and the lacunæ become hazy and deformed and ultimately vanish. Lacunæ are still visible in places after all signs of lamellæ have vanished. Ultimately we are left with a uniform granular matrix which is unidentifiable. As this type of bone is more readily destroyed by heat than compact bone a much smaller degree of burning is necessary to make histological study by decalcification impossible. Furthermore grinding sections is not practicable with spongy bone so that any sort of identification must then depend on analysis.

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The Laboratory and the Police Officer

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THE establishment of Regional Forensic Science Laboratories under the jurisdiction of the Home Office marks a new departure in the application of scientific aids to crime detection, so far as this country is concerned. It was inevitable for a time that the British police officer, commendably cautious as a consequence both of his training and experience, should show some degree of diffidence in making use of the facilities offered by the laboratories.

The period of " trying out " these institutions has now, however, been succeeded by one in which a spirit of friendly co-operation prevails. This is due in a large measure to a realisation that one of the essential functions of the laboratory is to *assist* the investigating officer in the completion of his cases. The word " assist " should be emphasised. It is no part of the work of the laboratory to complicate a perfectly straightforward case by supplying additional data, nor is it part of its work to bolster up a case which is fundamentally weak. It should be obvious that the work of the intelligent and experienced police officer provides the foundation upon which all successful case work is built. On the police side of an enquiry such an officer is the expert, and, in making use of the laboratory, he is inviting the collaboration of a fellow expert on certain of the material which he has encountered in the course of his investigation. Such collaboration, granted the right type of material, has frequently proved most fruitful, and the notes which follow will serve to illustrate this. We are indebted to the Chief Constables of Leeds and of the West Riding of Yorkshire respectively for their courteous permission to

publish details of these cases and for granting access to the police files dealing with them.

Case 1—Shopbreaking

A co-operative stores near Doncaster which had been left secure after the day's business was found early the following morning to have been entered through a ventilator window protected by a woven wire guard, which had been bent back and torn to afford ingress. Close examination of this revealed a small wisp of fibres attached to the torn portion. Several drawers had been forced and an attempt had been made to blow open a safe with an explosive, two sacks having been draped over the front of the safe, presumably to deaden the noise of the explosion. One of the sacks had a large hole blown through the middle, and the fibres surrounding this were fluffed out and the yarn partly disintegrated. Traces of disintegrated sack were scattered about the room and there was a quantity of other debris on the floor. Some of this consisted of fine paper " shavings " from biscuit tins, but, in addition, there were fragments of paint from the damaged safe, a piece of unburnt fuse, two yellow hexagonal pencils which had been sharpened so as to form long skewer-like structures, and small chips from these. Traces of clay were present in and around the damaged safe lock and it was considered likely that the pencils had, together with the clay, been used to tamp the explosive into the safe lock through the keyhole. All the material of various kinds was collected and carefully labelled.

As a result of police enquiries suspicion fell upon a miner who had been working at a local colliery. When questioned he stated that he had been in bed on the night of the shopbreaking and denied all knowledge of the offence. He was detained and his room was searched. A small flake of yellow-painted wood was found on the bedroom carpet and what appeared to be a small irregular angular flake of metal was found on the dressing-table cover. Both his spare clothing and his pit clothes were handed over to the investigating officers by his landlady, who before doing so found a 2 oz. tin of C.W.S. tobacco in one of the pockets. On being asked to account for

this, the suspect stated that he had bought it for a few coppers from a man whose name he didn't know.

The material collected from the scene, together with the clothing of the suspect and a carpet and mat from the bedroom at his lodgings, were packed in separate parcels and brought to the laboratory for examination.

The examination of the pit clothes revealed nothing of evidential value, but the suspect's other suit and the carpet and mat yielded a number of fragments of great interest. Small fluffy masses and isolated fibres of jute were present on the jacket, waistcoat and trousers of the suit and on the straw mat. Whilst the damaged sack from the stores was also a jute sack, the point of real significance which emerged was that the jute from the clothing and mat, like that of the sack, contained residues of a nitro-explosive and thus had a distinctive character. Adhering to the jacket was a fragment of black slightly tacky material. On microscopic examination this was found to consist mainly of linen fibres with a smaller quantity of cotton fibres. Some fibres of both kinds showed evidence of partial charring and all were impregnated with a black tarry substance. A comparison of the fragment with the wrapping of the fuse found at the scene showed a close agreement, since the fuse wrapping consisted of an outer cotton sheath enclosing a spirally twisted linen core, both of which were impregnated with black tarry material.

From the trousers, especially from the right turn-up, a number of irregular angular flakes of material were removed, and also a few fragments of narrow strips of tissue paper. Similar fragments of tissue paper were found on the mat. The angular flakes of material from the clothing and that from the dressing-table cover consisted of enamel showing a thin outer layer of glossy black with a thick grey undercoat. Some of these had particles of yellow clay adhering to them. A comparison of the flakes with control samples from the safe showed detailed agreement in both colour and chemical composition and also, in some specimens, in the presence of adhering yellow clay.

The small fragments of tissue paper were examined microscopically and found to be a high-grade bleached sulphite paper made from coniferous wood. Comparison of

these with the fine paper " shavings " from the shop showed detailed agreement. The small shaving of wood with the yellow-painted surface found in the suspect's bedroom was pencil cedar, and the yellow paint agreed in colour and chemical composition with that of the pencils found at the scene.

The wisp of fibres from the woven wire guard proved, on detailed examination, to consist mainly of wool fibres of ten different colours, together with occasional black, grey and white cotton fibres. These could all be matched in detail with fibres from the jacket of the suspect, and it is a point of some interest that this garment showed a small fresh tear in the back when received.

Whilst the laboratory examination was in progress the suspect's movements during the night and early morning of the date of the offence were carefully checked, and it was evident that he could easily have left his lodgings without attracting notice, committed the offence and got back again. Enquiries at the colliery showed that both the fuse and the explosive used were not employed for coal-getting locally, and no trace could be found of any casual vendor of tins of tobacco.

The prisoner was found guilty at the Leeds Assizes and sentenced to four years' penal servitude. Prior to passing sentence the Judge observed that the evidence of guilt was overwhelming. At the close of the case he sent for and complimented the detective officer who had handled the investigation.

Case 2—Attempted Shopbreaking

An officer who was on duty in a Leeds suburb on September 18th, 1938, noticed a stationary saloon car with one of the doors open standing near the premises of the local co-operative stores. As he approached the car, a man hurried from the shop doorway and jumped into the car, which was driven off at a fast speed. The car contained three men. The constable, who had noted the make (Ford) and registration number, went to the shop and saw that considerable damage had been done in an attempt to force an entry, this including among other things the smashing of a glass door panel, and the use of a heavy instrument on the doors at the front and rear of the buildings. He notified headquarters, who circulated the description and registration number of the car to neighbouring forces.

As a consequence the car was recognised and signalled to stop by two West Riding officers on motor patrol some distance outside Leeds. No attempt was made to stop, and the car was chased up to and along the Great North Road, the maximum speed registered by the police car being over 80 miles per hour. Ultimately the police car passed the saloon and halted in front of it, barring its further progress. The three men were taken into custody and a long flat iron bar was found on the floor of the car and taken possession of. This obviously showed traces of extraneous material and was protected pending detailed examination. In the meantime it was linked with a road repair site near the damaged stores, and was identified by the night watchman as one which he had loaned to one of the prisoners who had asked for it on the plea that the car jack was out of order. Samples of glass, woodwork and paint were collected from the scene and, together with the iron bar, were submitted to the laboratory for examination.

The prisoners denied all knowledge of the offence and declared that they had never been to Leeds and that they had spent the evening at Wakefield with three " birds " whose names they did not know. It was obviously desirable that their clothing should be examined, but all refused to permit this. Since they were on remand a Home Office order for the clothing was obtained, and the clothing and footwear was taken by a prison officer in the presence of the Governor, and made into three separate parcels.

Examination of the iron bar disclosed the presence on the rusted surface of a number of splinters of crushed Scots Pine, to some of which traces of yellow and brown grained paint were adhering. There was also a thin cake of compressed earth on the same part of the bar.

The damaged woodwork of one of the door frames at the store was Scots Pine painted with yellow and brown grained paint, identical in composition with that from the iron bar. In addition a well-defined instrument mark on the door was the same width as that of the iron bar and showed traces of rust and of earth agreeing in character with that on the bar.

Meanwhile the examination of the clothing of two of the prisoners had yielded a number of fragments of crushed wood, some showing traces of paint, and several fragments of glass. No significant material was recovered from the clothing of the third prisoner. The wood and paint agreed accurately with that of the door frame, and the glass was identical in character with that of the shattered glass panel of the door.

A further feature of considerable interest was the presence on some of the fragments of glass of traces of yellow metal. This proved to be genuine gold leaf agreeing in composition with that of the lettering on the glass panel. In addition, however, the fragments showed two other very characteristic features. As is well known, gilt lettering on glass may have either a glossy or a matt appearance or may combine both features. The matt surface is produced by a process of stippling, whilst the glossy surface is not stippled. Both types of surfacing were present on lettering from the damaged panel, and both occurred on the gilt fragments found on the clothing of the prisoners.

All three men were committed for trial, but one of them failed to surrender to his bail, and was not dealt with until a later Assize. The two who were first tried adhered to their alibi and asserted that the material found on their clothing had been " planted " by the police. Both were found guilty and sentenced to 2 years and 21 months respectively. The Judge passed some very severe comments on the attempts of the prisoners to discredit the evidence offered by the prosecution, and, commenting on the conduct of the officers who were instrumental in effecting the arrest, said " They did not know the characters of these men, and personally I should not have enjoyed riding in a motor-car with a man who, as the jury have heard, has been once sentenced to death. I think they deserve approbation and so far as I can do so I certainly commend them for their courage and conduct."

The third prisoner was not tried until after fifteen months had elapsed. He had in the meantime been arrested in the Metropolitan District and sentenced for other offences. He was handed over to the Leeds Police, found guilty on his trial, and sentenced to 18 months.

On Setting a Map and Fixing One's Position on a Map

IF a topographical map is to be something more than an example of the colour printer's art, a joy to look at, it must be made to serve several useful purposes. To most people the chief use of maps is to serve as guides on journeys whether for business or pleasure, and if a map is to be put to its best use the traveller must be able to fix his position on it. How often does one hear the question " Whereabouts on the map are we ? " followed by as many suggestions as there are persons examining the map ? It is to help the reader to fix his approximate position on a map whenever the occasion demands that this article has been written.

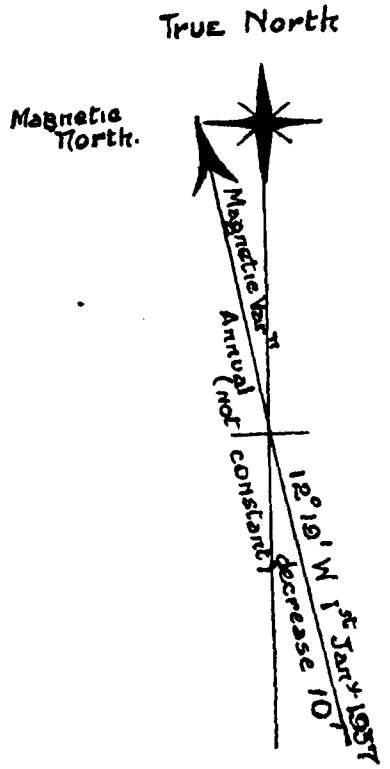

FIG. 1

The earth daily rotates on an axis which passes through the poles, and at each pole there is a point, the exact pole, where there is no movement. In relation to any point on the earth the positions of the poles are therefore fixed, and directions can be safely given only in terms of fixed points. A line drawn to the North Pole from any point A on the surface of the earth is called a meridian, and all points on that line between A and the Pole are said to be

due north of A. The direction from any point to the North Pole is known as True North. This direction is always shown by an arrow on ordnance maps (see Figure 1), usually in the north-east corner, and should be shown on all field sketches, however rough. All points on an ordnance map are placed in their exact relationship to true north. If by some means, therefore, the map can be placed so that the arrow showing true north direction points to true north on the ground the map is said to be set or oriented, and features marked on it can be readily identified.

It will now be clear that to set a map is simple if you are in the familiar country of your own patrol area. You simply stop at a known point, place the map on a flat surface, and turn it so that its true north arrow points to the north. By sighting from your position through their positions on the map you can readily identify buildings or features in the landscape, provided you are reasonably good at estimating distances. Conversely, by sighting on buildings or features in the landscape you can identify their positions on the map. Ground features and their positions on the map both lie on the line of sight, as you will find if you draw lines or " rays " radiating from your position on the map and sight along them. The directions of these lines are the directions of points along them on the ground and are known as bearings. A bearing is the angle between true north and the line or direction to objects sighted on the ground or on the map or to a line along which one is travelling. A bearing is measured in degrees, numbered clockwise from 0° to 360°. North is a bearing of 0° or 360°. East is 90°, south 180° and west 270°.

It is more difficult to set a map when you are uncertain of the direction of true north or when you are in a district with whose landscape and landmarks you are unfamiliar. There are, however, several ways of finding approximately the position of true north, or of otherwise setting the map.

During the daytime the sun at noon G.M.T., or at 1 p.m. summer time, indicates the position of south. If you are lost at noon (1 p.m. nowadays), turn your back to the sun and you will be facing north; and for some little time before and after noon the approximate direction obtained by this method

should be good enough. A shadow cast by a stick placed vertically in the ground points due north at midday, and is a better method than turning your back to the sun. If you want true direction, say three hours before or after midday, more care has to be taken. A watch will help you out of your troubles. Hold the watch horizontally near eye level so that the hour hand (during G.M.T.) points in the direction of the sun. South lies along a line drawn midway between that direction and the mark 12 o'clock on the dial, and north along the same line produced in the opposite direction. The principle behind this is simple (see Figure 2). The sun (apparently) moves through a circle of 360° (360 degrees) in 24 hours or $\frac{360^\circ}{24} = 15^\circ$ in 1 hour. Between 12 noon and 3 p.m. the sun has (apparently) moved through 45°. The twelve-hour dial on a watch shows that the hour hand has travelled 90° since noon, or just twice

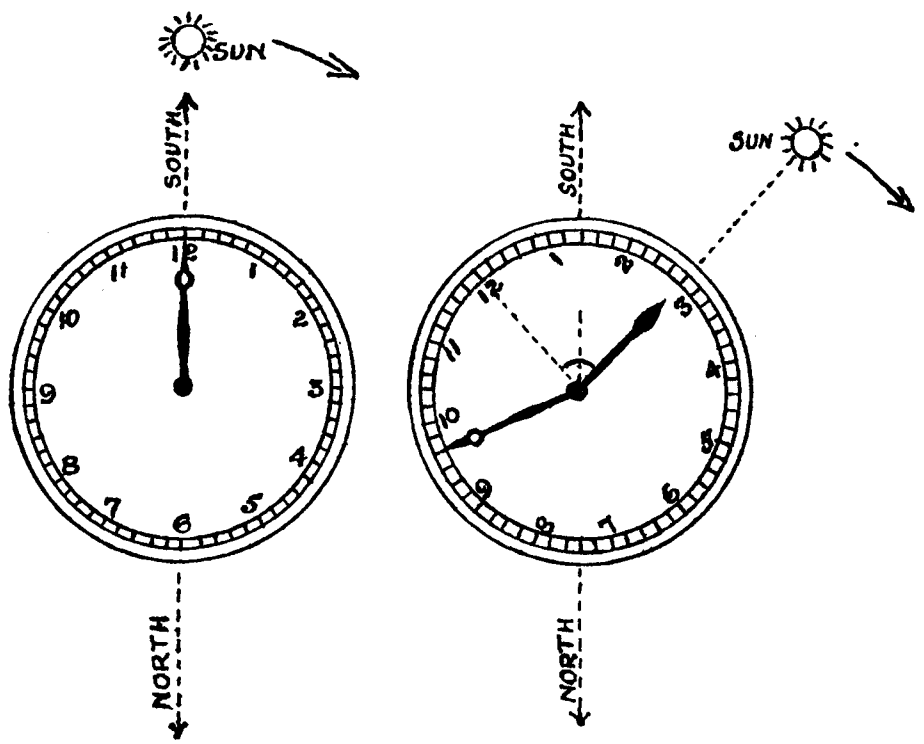

FIG. 2

too much. That is why, in order to find the south, you must halve the angle of travel on your watch. If the dial is divided into twenty-four hours, then due south is represented by the 0, or 24-hour mark, when the hour hand is directed towards the sun. During summer time you sight not along the hour hand, but along a line from the centre of the watch to the hour previous to summer time—in the case we have quoted along the 2 o'clock line.

This method has its limitations:

1. It is unwise to use it at times exceeding four hours before or after noon, as then the sun is apparently moving upwards or downwards as well as across the sky.
2. The farther we go from the Greenwich meridian, the more the actual sun time differs from the official time we all hope our watches show. This difference can be ignored in the kind of approximation we are trying to get.
3. The method assumes that at 12 noon the hour hand of your watch points exactly to 12 o'clock and not to a point halfway between 12 and 1. Amateur watch-menders are not always successful in ensuring correct replacement of the hands.

The chief disadvantage is that clouds often obscure the sun in this country, and the method can't then be used. When the sky is overcast, a few wrinkles will help you in any typical part of Britain. You have probably noticed that trees are rarely symmetrical, but have a lop-sided development, however slight. Branches grow better and longer on the side which receives most sun and light—on the south side in this country. Near the coasts all trees and hedgerows may lean in a certain direction, while the branches may show a lop-sided development amounting almost to deformation. This leaning is away from the coast and prevailing winds. Most villages have at least one walled garden, with fruit trees or rose trees. These usually face south, or show the best growth if they face south. Trees in the open often have moss on their trunks and branches. You will find that the moss is thickest on the north

side. This is a good general guide because occasional trees are found nearly everywhere, even high up on moorlands. Other clues to direction can be found in the age-old conservatism of man. From prehistoric times onwards the east has held for him some mystical virtue. So tombstones face eastwards, and so do the chancel windows of churches. Face east and the north lies on your left.

At night one must fall back on the Pole Star as a guide. The stars all revolve round the celestial North Pole, and the Pole Star is sufficiently near to this and sufficiently far from the earth to be regarded as a fixed point for practical purposes. At all times it is within 2 degrees of true north.

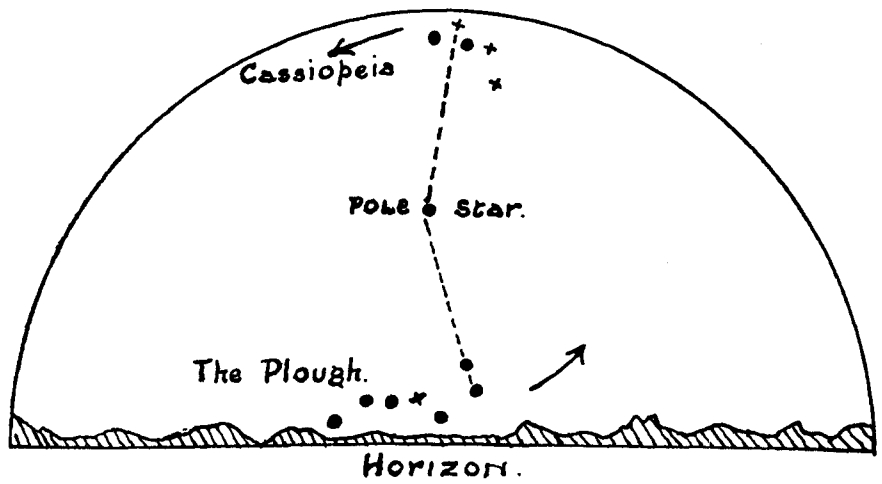

FIG. 3

At a greater distance a group of seven bright stars, known popularly as the Plough, the Great Bear or Charles's Wain, revolves anti-clockwise round the celestial North Pole. Actually the Pole Star also revolves round the celestial North Pole, but in a much smaller circle than that described by the Plough. The Pole Star and the Plough keep the same relative positions and neither sinks below the horizon in this country. The Pole Star is on a line drawn through the two stars or "pointers" shown in the diagram (Figure 3). Its distance from the nearest pointer is about five times the distance between the pointers.

If a partially clouded sky obscures the Plough, the direction of the Pole Star can often be found from another group of stars, Cassiopeia, as in the diagram. This is less easy than finding the position of north from the Plough.

Setting a Map by Compass

If you are in the habit of carrying a good compass it is simple to set the map. The compass needle does not point to true north, but to magnetic north, which from eastern England lies nearly 11½ degrees west of true north (Figure 1). Assuming the compass reads correctly, place it on the map and wait until the needle comes to rest. Turn the map gently until the line on the map pointing to magnetic north is parallel to the compass needle, when the line showing true north will point to the north on the ground. The map is automatically set if all these conditions are fulfilled.

The angle representing the difference between true north and magnetic north is known as the magnetic variation (Figure 1). It is not the same for all parts of this country; it is not constant, and it does not vary by the same amount each year. The map tells us both the variation on a given date and the approximate annual decrease of variation at the centre of the area represented on the map. In Figure 1 the variation is given as 12° 19′ west on January 1st, 1937, and we are told that the annual decrease of variation is 10′. On January 1st, 1941, the magnetic variation will be 12° 19′ − 40′ = 11° 39′ west.

For approximate map setting this annual decrease in variation can be ignored, but it must be allowed for in constructing accurate plans or in fixing positions correctly.

In using a compass two things at least should be borne in mind:

1. That iron or steel, e.g. penknives, metal on braces, spectacle frames, will affect the needle slightly: iron fences, railway lines and motor cars affect it greatly, and electric wires and cables affect it still more. Professional surveyors take care not to carry any iron or steel, and they get at least ten yards away from iron fences and at least 40 or 50 yards from telegraph wires when using the compass. For approximate readings you should get at least 5 yards away.
2. The needle is mounted on a pivot which in time gets worn or damaged and prevents free movement of the needle. A needle may be consistent in its error. In this case, by occasionally checking it against a perfect instrument, the " compass error " can be found and allowed for. A compass which reads erratically should be repaired or renewed. It is worse than useless.

Setting a Map by means of a Straight

If in the open country you can identify on the map a long straight section of road, railway, canal or edge of a wood, it is possible to set the map. Simply turn the map until the feature on the ground is parallel to its representation on the map. Strictly another point is still needed, as you may be 180° wrong; that is, the south of the map may point to the north unless you can identify some other object and see that the map is turned so that the object on the map lies in the correct relationship to the straight.

If you know your position X and can identify on the ground one other point Y which is also marked on the map, simply place a straight edge—*e.g.* the edge of an envelope, a book, but preferably a ruler—between X and Y and turn the map with the ruler in place until the edge is in line with the two points X and Y on the ground. The map is set. (Figure 4.)

If you are not sure of your exact position, select two points B and C in the landscape which are marked on the map, and move about until you are in line with them. Join B and C on the map as before and turn the map until that line is in line with the features on the ground. (Figure 5.)

In this method it does not matter whether you place yourself in line between the two features selected or outside them. In either case you might have to walk a long way before you can take up a position in line. It is, however, one of the surest methods in its results, and is worth the trouble. You are in a line with two fixed points which are mapped at their

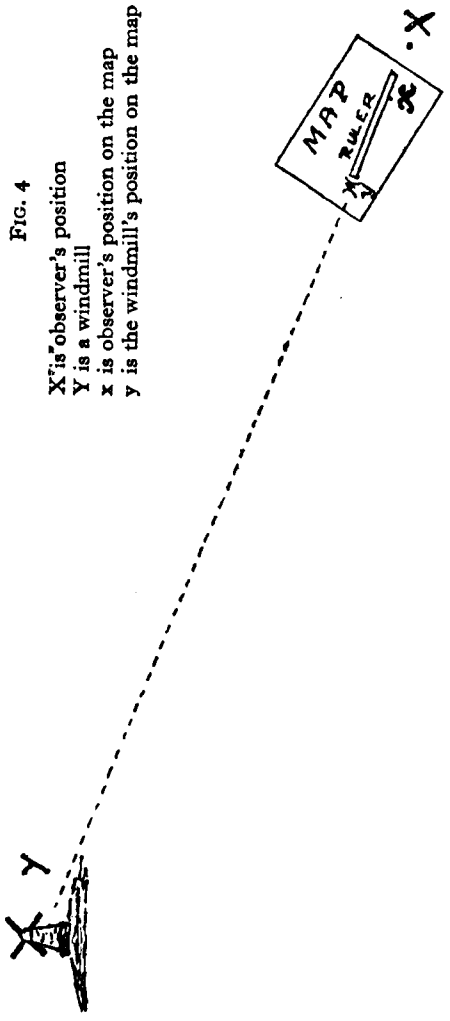

FIG. 4
X is observer's position
Y is a windmill
x is observer's position on the map
y is the windmill's position on the map

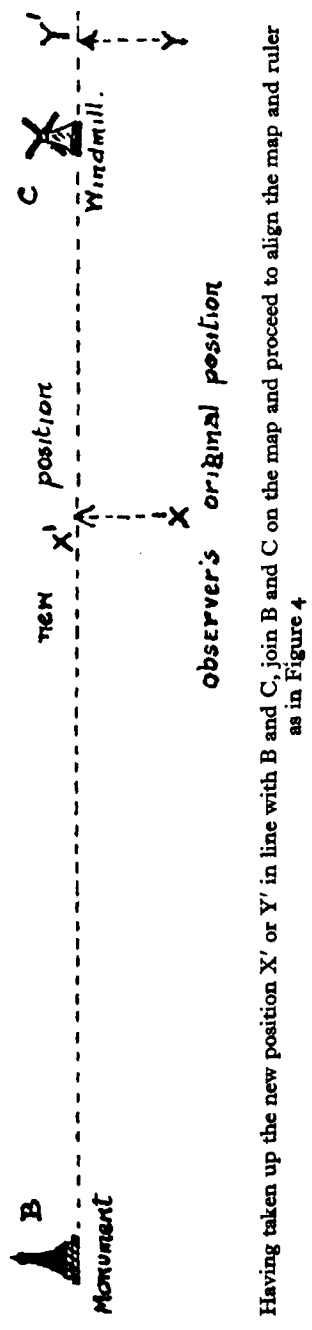

FIG. 5
Having taken up the new position X' or Y' in line with B and C, join B and C on the map and proceed to align the map and ruler as in Figure 4

proper angle to true north. It follows that once the line is made to coincide with the ground the map is set. At the bottom of an ordnance map you are told when the map was revised. Revision consists mainly, though not entirely, of putting in new buildings, and they are plotted on this principle of getting a sufficient number of points in line. The principle is also applied in inshore sailing.

Finding One's Position

So far the discussion has turned chiefly on setting a map, and in many cases it has been assumed that the position of the map-reader is known, more or less exactly. If that position is not exactly known there are means of finding it. The simplest method, if it is possible, is to get the intersection of two identifiable straights. Two such straight lines intersect only twice on the earth's surface—once in your vicinity and once in the Antipodes. Failing this you can try a second method. Using your general knowledge set the map as accurately as you can, and then commence to spot or identify features which are marked on the map. Thus you may find yourself on a moorland footpath and see several features around you—a stream, a third-class road, a group of houses about a mile away, and probably some rocks or marshes. The direction to these features on the map is easily found if the map is orientated, and all that it is necessary to do is to estimate the distances to these points and then approximately scale these off on the map and find your position. If any feature is fairly near and you are using a large-scale map, *e.g.* not less than 6 in. to 1 mile (a most unlikely event) distances may be paced or taped and then plotted to scale on the map. Map spotting depends mainly upon one's own observation and ingenuity and no general rules can be laid down. The method assumes that you know your approximate position, and that certain well-marked features are within a few miles' radius. In sparsely settled country districts the only recognisable objects may be many miles distant, and it may be impossible to map spot your position with any degree of accuracy. Faced with the problem of fixing one's position on the map in such circumstances a method known as " resection " may be adopted.

Officially resection is a complicated process for which expensive and rather cumbersome instruments are needed, and you are not likely to carry them. Fortunately it can be done graphically and sufficiently well for our purpose with nothing more expensive than a piece of board, an ordinary ruler, a pencil, a pin, a sheet of tracing paper and a flat surface on which to rest it. Place, or preferably fix, the tracing paper on the board and stick the pin through it in any convenient upright position. Pivoting the ruler against the pin, swing the ruler round until some well-marked feature, marked on your map, comes into your line of sight along the edge of the ruler. Then draw a line from the pin along the edge of the ruler touching the pin. The line drawn represents the direction to the feature

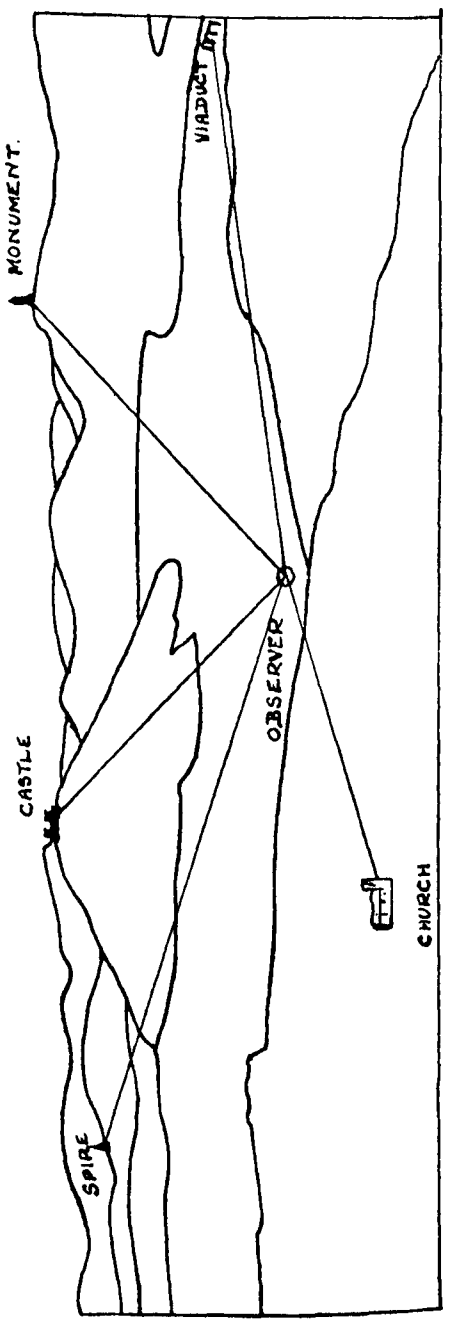

FIG. 6

sighted (Figure 6). Keeping the tracing paper in its fixed position, swing the ruler until another well-marked feature is sighted along its edge and draw another line. Repeat the process for a third point and preferably for a fourth and fifth; but not less than three. On the tracing paper you now have three or more straight lines radiating from the pin. Remove the tracing paper from the board, place it on the map, and move it about until the lines, or their elongations, pass through the points on the map representing the features sighted. The intersection of the lines, *i.e.* the pin point, now gives the position on the map at which you are standing. The position may be pricked through the tracing paper on to the map if necessary. It will be noticed that by using this method there is no need to orientate the map. The method does not give a perfectly accurate position, but the error, for general purposes, may be ignored. Note that even this simple method of finding one's position demands equipment that is not often available, and that it is dependent on the recognition of at least three features which are also marked on the map.

An alternative method of resection is by means of a prismatic compass. In this short article the instruction for using this type of compass cannot be given, but to those interested enough to buy one instructions are given with the instrument. In brief, instead of drawing lines on the tracing paper to represent the directions to three or more known objects in the field, those directions are measured as magnetic bearings and then plotted on the map by means of a protractor. The point of intersection of the lines again marks your position.

Finally a few words may be written on the accurate fixation of positions on a large-scale map, *e.g.* not less than 6 in. to 1 mile. Presumably at times it is desirable for the reader to fix on a map the site of a crime, or place of concealment of objects in open fields. Let us suppose that a murder has been committed in a very large field at a point Z, and the position of Z is to be placed on a 6 in. map (Figure 7). By map spotting the approximate locality of the crime can be determined by identifying certain features, *e.g.* a bridge over a stream (Y) and a group of farm buildings (X). It is now necessary to measure by chain or tape and two suitable points are selected from which

to measure. Remember that it is a large field and the shortest measurements might mean less work. B is a field corner and C the corner of a building, and both are marked on the map. Measure from C to Z (1,150′) and, to ensure straightness, erect a number of sticks or direct a companion in line as you go along. Then measure the distance from B to Z (400′). These two measurements are reduced to the scale of the map. With the compass point on B describe an arc of radius BZ to scale;

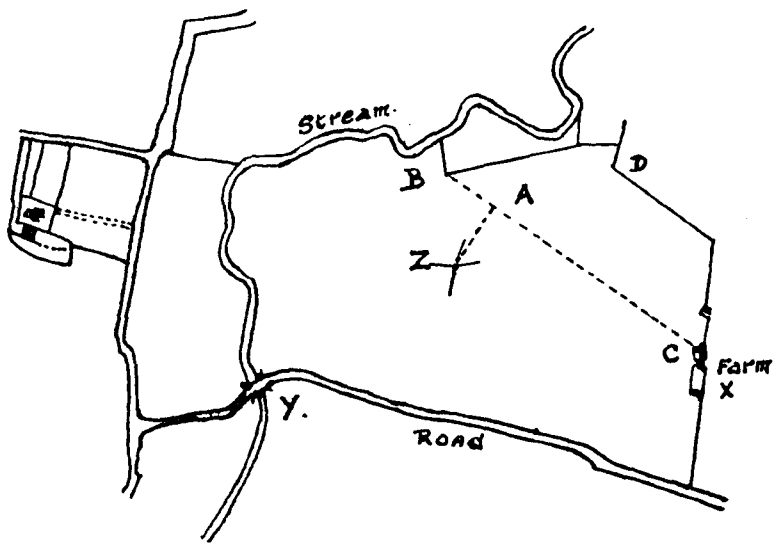

FIG. 7
Scale 1 : 10,560 or 6 in. to 1 mile

and then draw another arc to intersect it with the compass point on C and radius CZ to scale. The point of intersection is the point you want. When you have fixed this point you will curse yourself for not selecting D in preference to C, as this would have meant less measuring.

The position of Z can be determined in a different way. Measure along the line BC from B, and when you come to the point A on BC where a line from Z would meet BC at right angles put a peg in the ground. Measure the distance from A to Z. Turning to your map join the points on the map representing B and C. On it mark off, to scale, the measured

distance from B to A and from A draw a perpendicular in the direction of Z. Along this perpendicular mark off, to scale, the measured distance from A to Z and Z is now fixed. This method is not so good as the first owing to the difficulty of establishing the point A in practice.

A little thought and experiment will show that by using a simple tape for measuring distances on the ground, and by the wise choice of points on the ground already marked on large-scale maps, the position of unknown points can readily be marked by using either of the simple methods just described.

In conclusion, you should be warned that none of the methods described above should be regarded as accurate. Accuracy can be attained only by the aid of a fairly wide range of instruments and careful training in their use. The methods, however, are well known and after a little practice will give results good enough for ordinary purposes. Very little practice will convince you of their usefulness and urge you to that further practice which, we are told, puts one on the way to perfection.

H. KING.
F. J. FOWLER.

The Firearms Act, 1937

BEFORE the war it was, I believe, generally recognised in police circles that the Firearms Act, 1937, was not appreciated by the public to the extent to which it should have been, and the experience gained, particularly during the past few months, proves that it had in fact been abused.

Shortly after the war commenced, unregistered weapons of all descriptions duly surrendered by their owners began to trickle into police stations, and it was then that the earlier suspicions of the Police began to grow. Definite proof that the Firearms Act, 1937, had been abused was forthcoming when the Government made its appeal for weapons for the Home Guard, then known as the L.D.V., and again too when the Order came into being that lofts should be cleared. The trickle referred to soon became a steady flow.

The owners, when surrendering unregistered firearms, made various and often amusing excuses, chief among them being that the existence of the firearms had been forgotten, and to a lesser extent that it was not known about the Firearms Act. Many are the times when smiles have had to be hidden when an obviously retired Army officer has staggered into a police station with a load of " trophies," and what politeness has been shown while the history of them has been told! A few of the stories were interesting, and so good were the narrators that little imagination was needed to picture the various scenes. That, however, is by the way.

This article is written with a view to discussing ways and means by which the Firearms Act, 1937, can be, in the writer's opinion, more fully brought to the notice of the general public, without recourse to that best of all publicity—I refer, of course, to the prosecution of offenders.

The Firearms Act, 1937, gave the public the opportunity to place on record all the firearms in the country, at the low cost of the initial fee of 5s., and a renewal fee of 2s. 6d. every

three years. In thousands of cases, as is well known, free certificates were issued.

Of the thousands of unregistered firearms surrendered to the Police I think it safe to say that at least 35 per cent. of them would have entitled their owners to free certificates under Section 3 (3) (*c*) of the Act, had the necessary enquiry been made.

The Act was widely advertised, and it was openly stated in the press that no prosecutions would take place where persons declared their firearms before August 31st, 1937. A great number of people took advantage of this concession, but, as is now well known, thousands did not.

The war of 1914-18 was, of course, responsible to a great extent for the number of weapons held by the public, and it follows that at the end of the present conflict members of His Majesty's Forces will bring home their " trophies," and naturally will want to keep them.

How are the Police to bring to their notice that firearms gained in battle must be registered? It would appear that the method of using the Press alone, admirable though it is, is not sufficient, and it seems to me that the B.B.C. should be invited to play a greater part in advertising the Act. Generally speaking the press and the B.B.C. do a large amount of good advertising for the Police, but I do not think we make the most of their services.

There is no doubt that, at the end of hostilities, the Police will have to form a plan of campaign to educate the public as to the requirements of the Firearms Act (it does not get the everyday publicity of the Road Traffic Acts), and so I suggest that, as in 1937, the press be asked to give its valuable aid, and that announcements be made in the B.B.C. Announcements Programme. These announcements to be made periodically for a given length of time, and if the response is the same as in 1937, then the Police must bring it to the notice of the offenders by well-chosen and widely published prosecutions.

Now to the method of notifying the holder of a firearm certificate that it is due for renewal. While there is no necessity for the Police to do so, almost every Force sends out reminders, chiefly, I believe, by letter. In the Force to which I belong,

however, a list of certificates due for renewal is sent out divisionally from headquarters each month, and constables when on patrol deliver renewal forms to the holders. The list gives the date when the renewal is due, number of certificate, and name and address; a space is left for brief remarks to be made against each entry by the constable or divisional clerk, such as " handed renewal form 10-11-40," or " removed to ——." This method seems satisfactory, as if failure to renew leads to a prosecution the constable could say, if necessary, in the witness-box that on a certain date he handed to the defendant a renewal form with the request that the certificate should be renewed forthwith, whereas it cannot be proved that the holder of a firearm certificate received a reminder by post, unless, as is unlikely, it was sent by registered post.

It seems to me that all present systems of reminding could be dispensed with, particularly during war-time, and reliance placed in the B.B.C. and the press to make an announcement(s) at the beginning of each month that firearm certificates issued three years previously were due for renewal. It is a scheme which might well be tried.

Here too, dual announcements that persons who have permanently changed their address should notify the Chief Officer of Police by whom the certificate was issued would I am sure be a great help, particularly at the present time, when so many persons have evacuated. Although, in such cases, it can be argued that such a change is not permanent, this much can be said that many hours of enquiry would be saved, in cases in which renewal is due, if evacuee holders of firearm certificates did notify their change of address.

There are two amendments which I am going to suggest should be made to the Firearms Act, 1937; the first will probably be strongly criticised, and it is that there should be a slight alteration in the fees charged.

The fee of 5s. for a certificate which lasts three years is small compared with other articles which have to be licensed, *e.g.* 10s. for a gun licence which lasts for a year, or up to July 31st, irrespective of when it was taken out. In this connection I would suggest that 5s. be charged for the issue of a firearm certificate covering one weapon, an extra 1s. being

charged for each additional firearm. The same thing to apply on renewal, viz. 2s. 6d. and 1s. extra for each additional firearm.

This would result in a larger police revenue without any extra cost of collection, and it is reasonable to expect that if a person can afford to keep firearms, no matter how they were acquired (trophies excepted), the extra cost could be met.

The other amendment is to Section 11. By all means retain it, but I think that part which states that notification must be by registered post could be very well left out. A good percentage of the Notices of Sale are not registered; a thing which the Police conveniently overlook. The omission of the word " registered " would be a concession which I am sure would be appreciated by the firearm dealers.

W. KILBORN.

Metallurgical Examinations in Criminal Cases*

By GUSTAV W. PIRK

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(*Continued from Oct.-Dec.* 1940)

D. Polishing the Specimens

(1) *Preliminary Facing or Rough Grinding.* The purpose of preliminary facing is to produce a flat surface which is suitable for the following steps in the polishing procedure and which will remove the rough, irregular, and distorted surface left by sawing or cutting. This may be accomplished by filing, on grinding wheels, on prepared papers, by machining, or on a motor-driven abrasive belt. (Table I on page 100 indicates the best means of surfacing various types of metals.)

Filing and Grinding

In filing, the specimen should always be pushed against the cutting edges of a mill file as rubbing both forward and backward tends to round the edges of the specimen. The file should preferably be gripped in a vice or held in a fixed horizontal position. Under no circumstances should the specimen be gripped in a vice during any of the polishing process as such procedure is liable to disturb the microstructure of the metal.

Grinding wheels produce satisfactory results in the hands of experienced workers. They may, however, produce rounded or grooved surfaces unless the wheels are frequently dressed in order to maintain a flat wheel surface. The sides of the grinding wheel should be kept clean,

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free from clogged metal, and sharp. When using a grinding wheel, heating of the specimen should be carefully avoided by keeping the wheel copiously supplied with cold running water. Speeds above 1,200 r.p.m. are not recommended.

Endless motor-driven abrasive belts have also been found to give satisfactory results, and this method has the advantage that it is not limited to specimens of a rather small size but can be used with large pieces of metal.

Regardless of the method of preliminary facing, however, the specimen under all circumstances should be kept cool and at all times care exercised to avoid deep scratches or gouges as these have been known to alter the structure of the underlying metal, especially in the case of metals and alloys susceptible to structural changes by comparatively slight cold working, as, for example, tin, zinc, and lead.

When this procedure is completed, however, there remain relatively deep scratches and microscopic grooves on the specimen resulting from the rough facing tool, and it becomes necessary to continue the polishing procedure with more refined methods.

(2) *Grinding.* The next step is known as grinding. The object of grinding is to reduce by means of progressively finer abrasives the tool scratches which were left on the surface of the specimen in the preliminary facing process until there remains only a series of very fine scratches which can be readily eradicated in the final or fine polishing operation. Grinding may be carried out by hand, using metallographic papers, or by means of the paper glued to power-driven wheels. (See Table I.)

Grinding on Abrasive Papers

When grinding by hand on abrasive papers, the specimen is rubbed with a reciprocating motion to and from the operator, using just enough pressure to keep it firmly in contact with the paper. The paper should be backed by a plane-smooth, hard surface of either metal or plate glass. When going from one grade of paper to the next finer, the specimen should be rotated through an angle of 90° as this makes it easier to determine when the scratches from the preceding paper have been removed. Even when all scratches due to the coarser paper have apparently been removed, grinding on the present grade should be

continued for several minutes as an additional precaution to ensure that the coarser scratches are completely obliterated.

When the papers are glued to power-driven wheels the most important consideration is the linear velocity in feet per second (since it determines the cutting speed), and in order not to exceed the best working maximum linear velocity the wheel speed for a ten-inch disc should preferably be held under 600 r.p.m., although in some instances higher speeds have been successfully used. There must be no vibration. Hand grinding on abrasive papers is slower than machine grinding, but it has the advantage in that there is less heating and consequently less surface flow and distortion of the metal. In addition, hand grinding does not dislodge the non-metallic inclusions in steel which may in some cases be displaced by using power wheels.

A very important precaution during all of the various grinding and polishing operations is to completely wash all the abrasive from the specimen before going to the next finer grade. The specimen is then thoroughly dried. When using the cloth-covered polishing discs or wheels, a separate cloth, and, if possible, a separate head, should be used for each grade of abrasive. If it is not possible to use a separate head for each grade, then the new cloth should not be put on the disc until the polishing wheel has been thoroughly washed free from the previous and coarser abrasive.*

(3) *Rough Polishing*. Rough polishing can be considered as the last step of the grinding operation. It consists of a further smoothing or reduction of the fine microscopic scratches left on the surface of the specimen. It is generally carried out on cloth-covered wheels with No. 600 alundum flour or similar material either as a watery paste or an aqueous suspension. (See Table I.) This operation is extremely important, since upon it depends the success of the final polishing. It determines in a large measure the actual time required to complete the preparation of the specimen. If carelessly carried out, non-metallic inclusions in steel may be torn out, leaving a pitted surface, which gives a false impression of the cleanliness of the metal. If the rough polishing operation is rushed by exerting a heavy pressure or by forcing the specimen against the wheel, a relatively thick layer of flowed and distorted metal

* Also see Rodda, J. L., "Preparation of Graded Abrasives for Metallographic Polishing," Trans. Inst. Met. Division, A. I. M. M. E. 39: 149 (1932); Vilella, J. R., "Improved Method of Polishing Metallographic Specimens," Metals and Alloys 3: 205 (1932); and Dowell, R. L., & Wohll, M. J., "Metallographic Grinding with Paraffin Impregnated with Abrasives," Metals and Alloys 4: 181 (1933).

will be formed which must be removed before the true and representative structure of the metal is revealed.

(4) *The Final Polish*. The exact procedure used in carrying out the final polishing operation depends upon the purpose of the examination, but in all instances it is a wet polishing procedure which is carried out on cloth-covered rotating discs, or, when these are not available, by hand. Levigated alumina, magnesium oxide, and rouge are the usual abrasives. The first two are the most popular since they are cleaner to handle and do not stain the hands red. (Table I indicates some of the procedures to be employed in polishing common metals and their alloys.)

After the final polish is completed the sample should be free from scratches and when examined under the microscope should present a mirror-like and featureless surface, unless the constituents are of different colours or vary in hardness, or when the metal is relatively porous. Excellent examples of variation in colour of the constituents of the metal can be found in the case of ordinary commercial copper where the oxide is bluish and the pure copper salmon colour; in cast iron, where graphite inclusions appear as black flakes, and in most aluminium alloys. When the constituents vary in hardness selective polishing will take place and one constituent will wear faster than the other, leaving the latter standing in relief. Copper again is a good example, with the harder oxide standing out in relief as well as being readily distinguished by its colour. On the other hand, if the metal is porous, black spots and cavities will appear either over the entire surface or at least over a portion of it.

Microscopic examination at this point in the procedure is advantageous in determining the presence of inclusions, flaws and defects.

Polishing Precautions

1. Persistent scratches which mar the polished surface are a question of cleanliness. The chief causes are dirty hands, abrasive grits under the finger nails, coarse abrasive particles adhering to the sides of the specimen, and a cloth contaminated by flying grit. The latter cause can be eliminated by keeping the wheel tightly covered and protected

from flying grit when not in use. The remedy for the other defects is scrupulous cleanliness and thorough washing with warm water and a mild soap, such as Ivory, when going from the coarser to the next finer grade of abrasive.

2. During all wet polishing operations the specimen should be slowly and constantly moved in the reverse direction opposite to the rotation of the polishing disc, and from the centre to the circumference of the wheel. This will wear the cloth wheels evenly and assist in obtaining a uniform polish. The position of the specimen on each wheel is changed so as to polish with the next finer abrasive at right angle to the scratches left by the preceding coarser abrasive, that is, rotate the specimen through 90° before polishing with the next finer abrasive. If the metal is porous, the specimen should be rotated on its own axis during polishing in order to prevent forming " comet tails." This is generally a good practice to follow, especially on the last polishing wheel.

3. Rocking or uneven pressure will cause a rounding of the surface which is being polished and will destroy surface features. Under microscopic examination a round surface cannot be sharply focused over the entire field of view and consequently will yield " fuzzy " and " foggy " looking photomicrographs.

4. The preliminary surfacing, grinding, and paper work are of tremendous importance and should not be hurried or carelessly performed, because they are among the earlier steps in the polishing procedure. Any imperfections in these will not be removed by the final polishing operations. If the early work has been neglected, the surface after the final polish will be in a severely distorted condition, and upon etching will develop cross marks, scratches, or even a general surface roughness, which will obscure the true structural details of the metal. Observations made on an improperly prepared surface have no significance other than to indicate that some stage of the polishing procedure has been improperly carried out. The forced polish left by buffing is unsuitable for microscopic work since it leaves the surface badly distorted and smeared.

5. When using magnesium oxide as the final polishing material, distilled water must always be used. Ordinary tap water results in the formation of hard abrasive particles, magnesium carbonate, which can produce deep scratches and ruin the final polish. If magnesium oxide has been used as a final polishing abrasive, upon completion of the work the cloth should be thoroughly washed with distilled water.

6. New polishing cloths should be boiled in distilled water for several hours to soften their fibres. This step is especially desirable when polishing the softer metals and alloys. When not in use the cloths should be kept in distilled water containing a slight concentration (about 2 per cent.) of hydrochloric acid, especially if magnesium oxide has been used as a final polishing medium. If the cloths are left exposed

to the air, they will harden and cake due to the absorption of carbon dioxide from the atmosphere.

7. If it is necessary to interrupt any of the wet polishing steps even for only a few minutes, the sample should be thoroughly washed and dried. If left wet, iron and steel samples will corrode and become pitted, while non-ferrous metals and alloys may discolour or corrode.

E. Etching

During the polishing process a thin layer of flowed metal is formed on the surface of the specimen. In order to reveal the true structure of the metal or alloy this layer must be removed by treating the surface with a chemical reagent. This process is known as etching.

Etching is primarily a differential chemical attack on the various constituents which are present in a metallic aggregate. The value of a good etching reagent lies in the fact that it will develop the structure as it actually exists. The action of the etching reagent must not be too drastic or the contrast between the various constituents will be destroyed. The degree of activity can be controlled by using solutions of various concentrations, and it is a very rare occurrence when a concentrated etching reagent is employed where it is desirable to develop in detail the fine microstructure of the metal.

The structure of a metal, as it is seen under the microscope, is dependent upon its chemical composition as well as its thermal and mechanical treatment. Generally, a pure metal presents a polygonal structure, for although the metal is quite pure the surface will not be uniformly attacked by the etching reagent. Because of the random orientation of the crystals in a metallic aggregate various faces of the crystals are exposed to the etchant, and since some are more readily attacked than others a difference in level results between the crystals, the boundaries between them showing up as dark lines. Still a further effect of the etching reagent is to roughen the surface of the crystals and in some cases to form an oxide or a film on the surface. If the etching is continued for some time, microscopic valleys will actually develop at the grain boundaries. This differential attack on the crystals, which is dependent upon the particular crystal facet which is exposed, causes some

crystals to appear lighter than others. The variation in brightness over the surface of the specimen is due to the resulting unevenness of the metallic surface after etching, which causes light to reflect from each crystalline face at a different angle. Those crystals which have their surfaces so situated as to reflect the light up into the microscope tube to the eye will appear bright, whereas those whose surfaces reflect the light outside the microscope will appear dark. Because this effect depends upon the orientation or arrangement of the crystals, it is known as oriented lustre.

If an alloy is composed of two or more elements which produce a structure different from that of the pure metal, it may be identified by the peculiar form or structure exhibited. Very frequently the constituents of an alloy will be stained a characteristic colour, and by this means the elements of some alloys are recognised.

For metallographic work two types of etchings are used. The first, macro-etching, is employed to reveal the gross structure of the metal to either the naked eye or by examination with low-magnification (generally below 10×). (Figure 1 is an excellent illustration of macro-etched surfaces.) The second type, micro-etching, is employed to reveal the microstructure or fine details of the metal for examination at intermediate and high-magnifications. (The result of such an etching procedure is illustrated in Figure 3.) In preparing the surfaces for macro-etching it is generally not necessary to proceed beyond the grinding steps (*i.e.* to proceed beyond dry finishing of the surface), but for micro-etching, the specimen is usually completely polished.

The Technique of Etching

Before etching, the sample should be thoroughly cleaned and dried, and while being immersed in the etching reagent it should be kept in motion or swabbed with cotton. This procedure keeps a fresh portion of the reagent in contact with the sample at all times and removes any gas bubbles which may form as the result of the chemical attack, thus producing a more uniform etch.

The degree of etching must be carefully controlled and is generally accomplished by varying the time of etching, since for most routine inspections the manner of attack of the combinations of chemicals used is fairly well known. For examination at high magnification the degree of etching should be lighter than for low power work, since an etch suitable for low power (75-200 diameters) produces too much relief and thus makes sharp definition practically impossible at 500 diameters or above. It is therefore generally advisable to start with a light etch, completing first the high power examination, and then to etch somewhat deeper for the low power work. This procedure will prove time saving, for in order to perform an examination at high power after the specimen has been etched for low power work, it is necessary to go back to the No. 0 paper and completely repolish. If the high power work is done first, repolishing is obviously unnecessary.

Deep etching or over etching is to be avoided, and, if necessary, it is better to repeat the etching process several times than to over etch. In the case of stainless steel it may be necessary to polish, etch, repolish, and re-etch several times in order to remove completely the distorted metal produced by grinding and polishing and to expose finally the true structure. Aluminium and its alloys may also have to be repolished and re-etched once or twice to get fine definition.

In some cases, especially when two constituents are present, greater contrast can be obtained if a combination etch is used. For instance, when alpha and beta structures are present as in 60-40 brass, a ferric chloride etch following the regular ammonia-hydrogen peroxide etch adds contrast by darkening the beta constituents. In the case of phosphor bronze and copper, beautiful colouration and contrast can be obtained by following the ammonia-hydrogen peroxide etch by a few seconds of electrolytic etching. When studying the copper-beryllium alloys, much better results are generally obtained if a light etch of potassium bichromate precedes the electrolytic etch.

Electrolytic etching has much to commend it since considerable variation is possible by varying both the time of etching and the current density. This type of etching is particularly suited to the etching of tungsten, copper-nickel, copper-tin, and Monel metal.

Even when the entire polishing procedure has been properly carried out in every detail, there may be on the polished surface a thin layer of flowed or distorted metal. There is no better way of removing this layer than by alternate polishing and etching and this may be carried out as follows: The polished specimen is given a normal etch and the structure examined under the microscope, using the highest resolving power dry objective available. After this the sample is repolished on the final wheel, re-etched, and re-examined. This process is repeated as long as any changes appear in the structure. Normally one or two and not more than three repolishings are sufficient, but with soft metals more may be necessary. The procedure of deep etching sometimes used as an

attempted short cut usually results in pitting and obliteration of the fine structural details.*

Etching Techniques for Commonly Used Metals

Aluminium. For the macro-etching of aluminium a Tucker's† or Flick's‡ etch is perhaps the most useful, and satisfactory results are usually obtained when the reagent is applied to a smooth and well-ground surface. Either swabbing or immersing the specimen in the etchant is suitable, but unless the specimen is too large the latter is to be preferred. After etching the excess reagent is thoroughly washed from the surface and the specimen completely dried. For micro-etching either the 0·5 per cent. hydrofluoric acid etchant or 1 per cent. sodium hydroxide is generally the most useful and they are applied with a swab of soft absorbent cotton on a physician's applicator. The time of etching is about 10-15 seconds. This method gives uniform and satisfactory results and yields a surface suitable for photographing. The majority of the other reagents are useful for specific purposes, such as the identification of compounds or for revealing the grain structure of certain alloys.§

The following precautions should be observed in order to obtain the best results in etching aluminium and its alloys. Whenever etching by the immersion method specimens should not be held with metallic laboratory tongs as electrolysis which affects the etching rate may occur. Furthermore, it is extremely important to control both the temperature of the reagent and the specimen as well as the time of etching, while only the recommended concentrations of the reagents should be used. After etching is completed the excess reagent should be removed by washing in a stream of water, followed by rinsing in absolute alcohol and drying by a jet of air. The micro-constituents of aluminium alloys are

* For more extensive lists of reagents than appear in this paper, see Vilella, J. R., "Metallographic Technique for Steel," Am. Soc. Metals (1938); National Metals Handbook (1939); and the articles by the author in the General Electric Review *28* (8): 573 (1925) and *28* (11): 800 (1925); and in Wire and Wire Products *11* (8): 378; (9): 430 and (11): 648 (1936).

† Tucker's reagent is composed of hydrofluoric acid 15 cc., hydrochloric acid 45 c.c., nitric acid 15 c.c. and water 25 c.c. The specimen is immersed in the reagent. See also Tucker, C. M., Metals and Alloys *1* (August): 655 (1930).

‡ When using Flick's reagent the sample is immersed for 10-20 seconds, washed in warm water, followed by a dip in nitric acid. The reagent is prepared as follows: hydrofluoric acid 10 c.c., hydrochloric acid 15 c.c., and water 90 c.c. See Flick, F. B., "Etching Aluminium and Its Alloys for Macroscopic and Microscopic Examination," Trans. A. I. M. M. E. *71*: 816 (1925); Corson, M. G., Aluminium and Its Alloys, D. Van Nostrand Co., Inc., N. Y. City (1936) 239; Anderson, R. J., "Metallography of Aluminium," Chem. & Met. Eng. *17*: 64, 172 (1928); and Hanson, D., and Archbutt, S. L., "The Micrography of Aluminium and Its Alloys," Jr. Inst. Metals (British) *21* (1): 291 (1919).

§ Dix, E. H., and Keller, F., Mining & Metallurgy 9: 327 (1928); also see references cited in footnotes * and † above).

first and best studied on the polished surfaces and then by a systematic etching procedure.*

Copper. In macroscopic examinations, after the surface is prepared by grinding, rough polishing, or by cutting with a fine, well-sharpened tool, either a saturated solution of chromic acid, ferric chloride,† 20-50 per cent. nitric acid, or 20 per cent. ammonium persulphate is applied as the etchant either by swabbing with cotton or immersion.

For micro-etching of copper, ordinary (alpha) brass, and other copper alloys, ammonia plus hydrogen peroxide is the most generally used reagent. The proportions employed vary with the copper content of the specimen. Pure copper is etched with five parts (by volume) of ammonia, and five parts water, plus two parts hydrogen peroxide (9 per cent.). (Fresh hydrogen peroxide is necessary for best results.) However, when etching brass containing 65 per cent. copper, only one part hydrogen peroxide (9 per cent.) is added to the ammonia and water. When etching pure beta brass, the ammonia-hydrogen peroxide etch is usually followed by a ferric chloride etch to darken the second (beta) constituent.

Sometimes a combination etch must be used to obtain contrast or the correct colouration of two or more constituents. For example, copper and phosphor bronze can be very beautifully coloured if the ammonia-hydrogen peroxide etch is followed by an electrolytic etch for 2-5 seconds.‡ (If this procedure is followed the etched surface must not be swabbed, but is dried quickly by an alcohol rinse, or a blast of hot air.)

As a rule, the alloys of copper with manganese, silicon, beryllium, etc., can be satisfactorily etched with the bichromate reagent,§ whereas the ammonia-hydrogen peroxide etchant is inferior. The bichromate etch can also be used for leaded brass rods, Tobin bronze, and alloys of copper with nickel. As an alternative the copper-beryllium alloys can

* An excellent order of procedure for such examination is given by Dix, E. H., and Keller, W. D., Proc. A. S. T. M. *26*: part II (1926); and also Keller, F., Jr., and Wilcox, G. W., Metal Progress *23* (April): 45 (1933).

† Ferric chloride is used either for macro-etching or to give contrast following other bright etches such as chromic acid. The writer has found that a reagent consisting of 25 grams ferric chloride, 25 c.c. hydrochloric acid, and 100 c.c. water is a good general reagent for macro-etching copper and many of its alloys. The ferric chloride may be varied from 1 to 25 grams per 100 c.c. of water and hydrochloric acid from 6 to 50 c.c. See also Rosenhain, W., Introduction to the Study of Physical Metallurgy, D. Van Nostrand Co., Inc., N. Y. City (1914).

‡ A satisfactory electrolytic contrast etch, useful for bronze, nickel-silver, and other copper alloys is composed of ferrous sulphate 30 grams, sodium hydroxide 4 grams, sulphuric acid 100 c.c., and water 1,900 c.c. The sample is the anode, and platinum or stainless (18-8) steel is used as the cathode. Apply 0·1 ampere at 8-10 volts D.C. See also Hudson, O. F., Jr. Inst. Metals (London) *13*: 193 (1915) and Desch, C. H., Metallography, Longmans, Green & Co., N. Y. City (1913 and 1937).

§ The bichromate etch is prepared as follows: potassium bichromate 2 grams, sulphuric acid 8 c.c., sodium chloride (saturated soln.) 4 c.c., water 100 c.c. See Strauss, Jerome, Chem. & Met. Eng. 28 (19): 852 (1923) and Vilella, J. R., "Delving Into Metal Structures," The Iron Age, *117*: 761, 834 and 903 (1926).

be etched by first etching slightly with potassium bichromate and then following this by the ferrous sulphate electrolytic etch.

Whenever specimens of copper and its alloys are etched, the following instructions are to be observed. After etching the specimen should be washed with running water, rinsed in absolute alcohol, and dried with an air blast. The etched surface may be preserved from tarnishing by coating it with a thin layer of oil or glycerine or for permanent protection with a clear, transparent lacquer. At times it is desirable when etching for microscopic examination to hold the specimen with platinum tipped forceps, rather than ordinary nickel tongs, especially if the more corrosive reagents are used.

The time required for etching copper increases with the amount of annealing given the material, and decreases with the degree of cold-working.

Iron and Steel. The most generally useful reagents are dilute solutions of picric acid and nitric acid in alcohol.* When it is necessary to detect the various carbides in steel, however, various alkaline etching

* The picric and nitric acid reagents are prepared as follows, and reveal the structures noted:

Nitric Acid (Nital)—Nitric acid (sp. gr. 1·42) 1·5 c.c., ethyl alcohol (95 per cent. or absolute) 100 c.c. Etching rate is increased, selectivity decreased, as the per cent. nitric acid is increased. 4 per cent. in amyl alcohol useful to develop grain boundaries and contrast in low carbon materials. Etching time a few seconds to a minute. Used on carbon steels (1) to darken pearlite colonies, (2) to bring out Ferrite (iron) grain boundaries clearly, (3) to differentiate Ferrite (iron) from Martensite (a structure found in heat treated steel). For cast iron, carbides are unetched.

Picric Acid (Picral)—Picric acid (clean, dry crystals) 4-5 grs., ethyl alcohol (95 per cent. or absolute) 100 c.c. (Use *absolute* alcohol only when crystals contain 10 per cent. or more of moisture.) This reagent is superior to " Nital " except for specific uses listed above. " Picral " shows detail more delicately than " Nital," but does not reveal grain boundaries as readily as " Nital." Etching time a few seconds to a minute or more. Used for all grades of carbon steel in the (1) annealed, (2) normalised, (3) quenched, (4) quenched and tempered, (5) spherodised, and (6) austempered condition. Also useful for all low alloy steels attacked by this reagent.

A saturated solution of ferric chloride in hydrochloric acid to which a little nitric acid has been added is used to develop the structure of stainless steel. This reagent is used full strength. With many of the stainless irons and steels the method of alternate polishing and etching must be used. The 18-8 and other alloys can be etched by means of the following reagents: nitric acid 10 c.c., hydrochloric acid 20-30 c.c., glycerol 20-30 c.c. (The specimen is warmed in water before etching.) This reagent is also useful for high-speed steel. However, in the totally austenitic stainless alloys such as 18-8, the following reagent gives better results: nitric acid 10 c.c., hydrochloric acid 20 c.c., glycerol 20 c.c., and hydrogen peroxide 10 c.c. The speed of etching can be varied by varying the amount of hydrochloric acid. (For special alloys the hydrogen peroxide can be replaced by an equal quantity of acetic acid.)

Ten grams of oxalic acid in 100 c.c. of water may also be used as an electrolytic etch. The specimen is the anode while the cathode is of stainless steel or platinum, the two being about one inch apart. The voltage varies between 6-30 volts and the time from 10 seconds to one minute, depending on the structures that it is desired to reveal. See Ellinger, Trans. A. S. M., *24* (1): 28 (1936) and Arness, W. B., Trans. A. S. M., *24*: 701.

reagents are employed,* while cupric chloride reagents are used to reveal phosphorus segregation.†

At times a piece of steel can be identified by identifying its various inclusions.‡

In etching iron and steel specimens the time and temperature must be carefully controlled, and the specimen should be kept in motion while immersed to prevent gas bubbles from clinging to the surface and causing a non-uniform etch. When the etching is complete the specimen should be thoroughly washed with warm water, immersed in absolute alcohol, and dried in a warm air blast. Once etching is completed the specimen must not be rubbed.

The most useful reagents for macro-etching are 50 per cent. hydrochloric acid§ and various concentrations of nitric and sulphuric acids. When examining iron and steel for surface defects such as seams, laps, fins, grindings, cracks, etc., special preparation is not needed, since the etching reagent will remove surface deposits such as scale. For revealing defects in the interior of a bar a section, of course, must be prepared. When using hydrochloric acid a machined surface is sufficient, but some

* Sodium Picrate (Alkaline)—Picric acid 2 grams, sodium hydroxide 25 grams, water 100 c.c. This reagent may be used boiling (10-15 minutes), but preferably electrolytically at room temperature. The specimen is anode, cathode is platinum or stainless steel. (Six volts D.C., 40 seconds generally sufficient.)

The etchant attacks sulphides and colours Cementite (iron carbide), but carbides high in chromium (in tungsten steel), iron tungstide (Fe_2W), and iron tungsten carbide (Fe_4W_2C) are coloured more rapidly than Cementite, but tungsten carbide is unattacked. It outlines grain boundaries in steels containing more than 0·80-0·90 per cent. carbon in the slowly cooled condition.

† The phosphorous reagent is made as follows: cupric chloride 1 gram, magnesium chloride 4 grams, hydrochloric acid 1 c.c., water 20 c.c., alcohol (absolute) 100 c.c. (Dissolve salts in least possible quantity of hot water.) Etching time is one minute, which is repeated if necessary.

This reagent is used to show phosphorus segregation or other elements in solid solution as copper tends to deposit first on areas lowest in phosphorus.

‡ Wohrman, C. R., " Inclusions in Iron," American Society for Metals, Cleveland.

§ The 50 per cent. hydrochloric macro-etch consists of equal parts of acid and water and is used hot (160-175° F.) for from 15 minutes to half-hour, depending on the steel, to reveal flow lines, cracks, porosity, and dendrites. A good universal macroreagent consists of hydrochloric acid 500 c.c., sulphuric acid 70 c.c., water 180 c.c., and is used at 160-175° F. for from 1-2 hours.

Strain lines and obliterated numbers on firearms may be restored by means of Fry's reagent, which is cupric chloride 90 grams, hydrochloric acid 120 c.c., and water 100 c.c. At times the contrast may be increased by reducing the cupric chloride to 45 grms. and increasing the hydrochloric acid to 180 c.c.

It is most useful for mild steel, particularly Bessemer Steel, and when so used it may be necessary to heat the specimen 5-30 minutes at 300-475° F., depending on the condition of the steel. During etching the surface should be rubbed with a cloth soaked in the etching solution, and after etching washed in alcohol or rinsed in 1 : 1 HCl to prevent copper deposition. When it is used to restore obliterated numbers on firearms, the etching time may run into hours. The reagent should be applied to a finely ground or polished surface. Also see Yatsevitch, M. G., " The Macro-Examination of Steel," Army Ordnance, January and February, 1931.

reagents, such as Humfrey's, Le Chatlier's, 10-20 per cent. ammonium persulphate,* etc., require a well-polished surface for best results.

Whenever the hydrochloric acid etchant is used on steel, best results are obtained with a fresh solution at a temperature at about 160° F. This reagent must be used under a hood since the fumes are very corrosive. Before beginning to etch the specimen it should be carefully washed either in soap and water or petrol to remove grease and dirt and then heated in hot water to 160° F. This procedure makes it much easier to duplicate conditions and to control the time element since both the specimen and the etchant are then at the same temperature.

With all reagents the actual time of etching varies for different steels and even for the same steel in various conditions. For example, in the annealed state the time may vary from 15 minutes for the plain carbon steel to 45 or 60 minutes for the highly alloyed steel, such as nickel-chromium, nickel-chrome-vanadium, tungsten, and high speed steels.

After the specimen is etched, it should be removed and washed entirely free from acid in running water. The black " smut " deposited should be thoroughly scrubbed off with a stiff bristled brush. The specimen may be either blotted dry after washing or dried by an air blast or live steam. If it is to be preserved for some time, it should be completely freed from acids by placing it in plain boiling water or boiling water containing a little soda, followed by several rinsings in hot water. For permanent protection the surface should be coated with transparent lacquer or collodion. If the sample is to be photographed, the contrast can be increased by coating the surface with a thin film of glycerine.

Magnesium. The glycol etchant† is perhaps the most useful reagent for the present-day magnesium alloys. Its value lies in the fact that it clearly delineates the various structural constituents of magnesium alloys and makes their identification positive. It is mild in its action and does not severely attack or pit either the alloy constituent or the matrix.

A convenient method of applying the reagent is to pour the etchant into a watch glass or small porcelain evaporating dish, and with a sliding motion immerse the specimen face downward. The specimen must not

* The grounded or polished surface should be rubbed with absorbent cotton dipped in a freshly prepared solution. (Etch half-minute or more.) This reagent is particularly good for welds.

† The composition of the glycol reagent is diethylene glycol 75 c.c., distilled water 24 c.c., concentrated nitric acid 1 c.c. (Etch either by immersion or swabbing.) If diethylene glycol is not available, 5 per cent. citric acid in water may be used and applied in the same manner. Oxalic acid (2 per cent.) has also been used, and for macro-etching 10 per cent. solution of glacial acetic acid in water is satisfactory. (Apply the last two by swabbing.) When etching is completed rinse in warm water and then immerse in acetone and dry in a warm air blast. The time varies from 2-5 seconds for the oxalic acid etch up to 2 minutes for the acetic acid etch. Also see Gann, J. A., " Treatment and Structure of Magnesium Alloys," Trans. Inst. Metals. Div. A. I. M. M. E. p. 309 (1929).

be allowed to touch or scrape on the bottom of the receptacle, and should be moved around in the etching solution to ensure thorough and uniform wetting of the surface and to dislodge any gas bubbles which may form. The time of etching is 10-15 seconds but under some conditions this may be extended to 30 seconds. After obtaining the desired etch, remove the sample from the reagent, blow on the polished surface to remove any gas bubbles and the excess etching reagent, and then plunge it into boiling water.

Nickel. Nickel, monel and cupro-nickel and other nickel are best etched with nitric acid plus glacial acetic acid,* or with an electrolytic etch.† Over-etching of nickel and its alloys will invariably lead to pitting. After etching it is especially necessary with nickel to wash thoroughly with water, rinse in alcohol, and dry quickly with a clean air blast. The electrolytic contrast solution will stain less than the flat solution, and if a few stains develop with the flat solution, these may usually be removed by gently wiping the surface with clean, soft linen or cotton cloth. When the specimen has been severely cold worked as by rolling, deep drawing, etc., good results will only be obtained with the flat solution, and it also gives best results when studying the specimen for inclusions, flaws, and porosity. However, grain size uniformity is best studied by means of the electrolytic etch.‡

Precious Metals. The precious metals are more difficult to etch than the other metals. The usual procedures and precautions must be carefully followed.§

* Flat Solution—Nitric acid (Conc.) 10 c.c., acetic acid (glacial) 50 c.c. (Prepare fresh daily and use only colourless nitric acid to prevent staining.) Etch by immersion for 5-20 seconds at room temperature. Dilute with 25-50 per cent. of acetone when etching alloys with less than 25 per cent. nickel.

† Electrolytic Contrast Solution—Nitric acid (Conc.) 10 c.c., acetic acid (glacial) 5 c.c., water 85 c.c.

Use 1·5 volt dry cell, with platinum wires, and etch for 20-60 seconds. Excellent for grain size studies, gives good contrast, and stains less than flat solution. The writer has found that the addition of 2-3 c.c. of phosphoric acid greatly reduces the tendency of staining and still gives good contrast.

The optimum amount of phosphoric acid will also vary with the condition of the cupro-nickel (*i.e.*, with more extensive cold work more phosphoric acid may be used.)

‡ Nitric Acid (30 per cent.)—Nitric acid (conc.) 30 c.c., water 70 c.c. is a good macro-etch for nickel-silver. (Etch by immersion.) Also see Mudge, W. A., " Etching Solutions for Nickel and Nickel Alloys," Nat. Metals Handbook; and Adcock, F., " Internal Mechanism of Cold Work and Recrystallisation in Cupro-Nickel," Jr. Inst. Metals (British), *27*: 74 (1922).

§ Platinum and palladium are etched by means of aqua regia and concentrated nitric acid respectively. Gold and its alloys are etched by using equal parts of 10 per cent. potassium cyanide (*Poison*) and 10 per cent. ammonium persulphate solutions. (Etch half to 3 minutes.) Also see Carter, F. E., " Platinum Metals and Their Alloys," Proc. Inst. Met. Division A. I. M. M. E. p. 766 (1928).

Silver and silver alloys may be etched by means of the following reagent: Potassium dichromate (saturated sol.) 100 c.c., sodium chloride (saturated sol.) 2 c.c., and sulphuric acid (conc. sol.) 10 c.c. For use, take one part of this solution and 9 parts of distilled water and apply by swabbing.

EXAMINATION OF SPECIMENS—SURFACES TO BE CONSIDERED

When should the technician begin his microscopic examination? Should he examine the polished surface or defer the examination until the etching process has been completed? The illustration shown in Figure 7 indicates the advisability of pursuing a practice of examining the surface before as well as after it has been etched. *A* and *B* of that illustration represent, respectively, the unetched and etched surfaces of the same longitudinal sections of a flat copper strip containing a surface defect known as a sliver. It will be observed that although the etching reagent did develop (in *B*) the small, uniform grain size of the specimens, it practically obliterated the oxide particles (shown in *A*), which were indicative of the presence in the metal of an excessive amount of oxide.

As previously stated, it is an unwise practice to confine the microscopic examination to either a transverse or a longitudinal section of the specimen. It is far better to examine both types of sections. In most instances the dual examination will reveal two sorts of evidentiary matter—one confirmatory of the other. In some instances, however, one type of section will fail to disclose the desired information, whereas the other will be very productive of significant results. A typical example of the latter situation is furnished by a bi-metallic wire examination. A transverse sample of bi-metallic wire will be much more helpful for identification purposes than a longitudinal section. Consequently, if a technician relied solely upon a longitudinal section and neglected the examination of a cross-section sample he might be defeated in his attempt at effecting an identification. For instance, see Figure 8, an illustration from an actual case in which a comparison between the contours of the steel-copper junctions in two pieces of steel-core copper-coated wire yielded valuable evidence bearing on the question of the identity of the two specimens of wire. In this case longitudinal sections would not have been very helpful because the varying thicknesses of the copper coating would appear comparatively uniform in the longitudinal plane.

In concluding this discussion it might be of advantage to review briefly some of the types of cases to which the metallurgical technique is applicable, and also point out some of its limitations.

Like other procedures, metallurgical technique does not offer a universal solution for every case in which a metallic object is involved. For example, suppose a blasting cap becomes accidentally admixed with some coal, and that on tending the furnace the portion containing the explosive is thrown on the fire, with a resulting fatal explosion. The finding of small pieces of copper and copper wire is in this case not sufficient reason for an extensive microscopic and metallurgical examination. The circumstances surrounding the case determine the procedure to be adopted, and in this case an explosives expert would be decidedly more useful than a metallurgist. If, however, a fabricated bomb is thrown or set off and pieces of metal are found in the evidence, then these should be carefully collected and preserved, and compared with similar pieces which might be found in the possession of a suspect. The two cases referred to previously are good examples. Other types of cases where metallurgical procedures are useful are (1) the bursting or explosion of fire arms, (2) the unexplainable and sudden failure of machine parts, (3) elevator accidents, such as failure of the hoisting cables, and (4) in any case where the question of fixing liability for a failure is essential, or where malicious acts are suspected.

Recently the writer was asked to examine a burst revolver cylinder. There was no fatality, but the questions to be answered were (1) was the cylinder defective, or (2) since reloaded ammunition was used, was a heavy powder charge introduced into the cartridge case. In this case three sections were prepared for microscopic examination, a cross-section taken at right angles to the plane of fracture, and two longitudinal sections. One of these was in the plane of the fracture and the other at right angles to the plane of fracture. The value of supporting evidence is also demonstrated by this case, for in addition a chemical analysis was made, together with an examination of the gun by a firearms identification expert. All the evidence collected pointed to the conclusion that the metal was in no way defective.

The important point to bear in mind is that metallurgical

TABLE I

Summary of Cutting and Polishing Procedures for Various Metals and Their Alloys

	Nickel	*Iron and Steel*	*Precious Metals*
Cutting	Hack saw or machining.	Hack saw, cutting-off wheel, or machining.	Hack saw or machining.
Preliminary Surfacing	File with light pressure.	Filing, grinding, or endless abrasive belt.	Flat, single cut file.
Grinding	Carborundum papers Nos. 180, 240, 320, and 400 by hand or glued on discs rotating at 300-600 R.P.M. Use light pressure. (No. 400 paper best if worn and graphited.)	On Nos. 2, 1, 0, 00, and 000 metallographic papers or on wheels covered with paraffin-impregnated billiard cloth or canvas using abrasive grains Nos. 280, 320, and 400. Canvas cloths best for coarser grade abrasives.	Nos. 240, 280, 320, and 400 grain aloxite paper, followed by 000 and 0000 metallographic paper, which were smoothed by rubbing with a piece of hardened steel.
Rough Polishing	Billiard cloth covered wheel with a suspension of No. 600 alundum in water. Avoid excess water on wheel. Speed 300-400 R.P.M.	No. 600 emery (or finer) on paraffin impregnated billiard cloth covered wheel.	Well moistened felt covered wheel, using No. 600 alundum.
Final Polishing	To show micro-structure use billiard cloth covered wheel with levigated alumina settling at rate of ¼ to 1 inch per hour. To show inclusions use flat silk crepe cloth and levigated alumina.	Depends on purpose of examination. To study non-metallic inclusions use hard, pileless cloth on wheel, such as good quality cotton or linen cloth, dull side of heavy silk satin, or good flat crepe. For high power examination to study micro-structural details use softer cloth, such as "Kitten's Ear" broadcloth, with levigated alumina or fine magnesium oxide. Wheel speed 280-300 R.P.M.	Velvet covered wheel, using U.S.P. *heavy* magnesium oxide paste (made with distilled water) or levigated alumina, settling at a rate of 0·25 inch per hour.[1]

	Aluminium	*Copper*	*Magnesium*
Cutting	Hack saw or machining.	Hack saw or machining.	Hack saw or machining.
Preliminary Surfacing	Medium mill file.	Medium mill file or endless abrasive belt.	"Regular Cut" file followed by strokes on a "Second Cut" file.
Grinding	Nos. 0, 00, and 000 metallographic paper coated with a solution of paraffin in gasoline.	Nos. 0, 00, and 000 metallographic paper.	Nos. 1, 00, and 0000 emery papers. Kerosene may be used on papers to prevent fouling.
Rough Polishing	No. 600 alundum flour suspended in water; broadcloth covered wheel turning at 300 R.P.M.	(1) FF Turkish emery, No. 500 carborundum, or Nos. 400 or 600 alundum, depending on depth of scratches left by paper. No. 600 usually satisfactory. (2) Tripoli on a wool broadcloth wheel or two felt-covered wheels, one using "RF" and the second, "SF6X" emery.	6SF alundum worked into paste with water on wheel covered with fine grade of broadcloth. Speed 500 R.P.M. Avoid excessive pressure and long contact with wheel. Having removed paper scratches, wash cloth free of abrasive with water. Hold bar of Ivory soap against wheel to make good lather. Hold specimen *lightly* against wheel (speed 300 R.P.M.) and move in direction opposite the wheel rotation until surface is bright and highly reflective.
Final Polishing	Merck's heavy magnesium oxide powder[2] well worked into wheel covered with "Kitten's Ear" broadcloth rotating at 150-200 R.P.M. Rotate through 90° frequently to reduce surface flow. Keep polishing cloth moist at all times with distilled water. As previous scratches are removed, wash cloth practically free of polishing material and hold specimen against the revolving polishing disc, using a copious supply of distilled water. Care at this point is essential to attain a good polish. Chemical composition and temper of the specimen determine the exact pressure to be used. After polishing is complete wash sample free of the last traces of polishing material in stream of tap water and dry by blowing the excess water from the surface. Do not rub or touch the polished surface.[3]	A water suspension of levigated alumina or finely powdered magnesium oxide on wheel covered with fine grade of wool or "Kitten's Ear" broadcloth rotating at 600-800 R.P.M. Use distilled water with magnesium oxide; work into cloth with fingers, pushing coarse particles to edge of polishing wheel. After removal from the final wheel the specimen may be etched immediately, or rinsed free from abrasive in warm water, washed with alcohol, dried quickly, and then etched.	Cover wheel with closely woven silk-velvet of short but full-bodied nap and work small quantity of Merck's U.S.P. *heavy* magnesium oxide into nap with fingers, using *distilled* water. Press specimen firmly against wheel (speed 150 R.P.M.) and rotate specimen in opposite direction of wheel two or three times. Reduce speed to 100 R.P.M. With very slight pressure rotate specimen in opposite direction of wheel 2-3 minutes.[4] Then flood wheel with distilled water to remove any remaining polishing powder from both cloth and specimen. (Complete removal of the polishing materials is expedited by slightly increasing the pressure of the sample against the wheel for a few seconds.) Quickly plunge specimen into hot distilled water, remove immediately, and dry with sharp air blast. (This procedure is superior to the alcohol rinse procedure.)

[1] See R. H. Leach and C. H. Chatfield, Proc. Inst. Met. Div., A. I. M. M. E., pp. 743-51 (1928).
[2] The magnesium oxide used must be free from caustic or an undesirable etching effect will occur.
[3] Specimens of most metals will retain their polish and brilliance for long periods of time if stored in a desiccator. See Dix, E. H., Jr., Chem. and Met. Eng., *27*: 1217 (1922), and National Metals Handbook (1939)
[4] See J. A. Gann, Trans. Inst. Metals Division, A. I. M. M. E., p. 309 (1929), and Dow Metal Laboratory Methods (1933), The Dow Chemical Co., Midland, Mich.; also Nat. Metals Handbook, p. 591 (1939).

techniques, like other procedures, are not always in themselves sufficient to establish the identity between two pieces of metal. Neither should every metallographic examination be expected to result in establishing the identity between two metallic objects. As with other evidence, the more data that can be collected, the more complete will be the evidence, and in addition the value of the individual pieces of evidence will also be enhanced thereby. Although it is possible that non-identity will be found in more cases than identity, it is always well to have a metallographic examination performed where the importance of the case justifies this and where it is advisable to know the answer, even if it is negative. If this policy is adhered to, the possibility of overlooking valuable evidence will be minimised. In some cases the negative answer may be valuable in refuting the evidence of the opposition and will thus serve a very useful purpose and justify the expense incurred in obtaining it.

Towards Promotion

III. Qualifying for Leadership

IN the two previous articles on the aim towards promotion, suitable emphasis has been placed on the need for an educational background, and its value not only in carrying the burden of the early stages of training and in learning the routine of police duties, but as the foundation for the course of study which is necessary if the obstacles presented by the qualifying examinations are to be successfully negotiated. An attempt has also been made to keep the academic side of police duty in true perspective, for important and valuable though educational ability is, advancement in rank demands also those other qualities, of judgment, courage and leadership, without which no man who is put in authority over other men can hope to succeed.

What are the qualities of leadership which the police service demands of those who aim to fill the higher ranks? In seeking the answer to this question, in the course of the present article, let us abandon the ideal for the real, and temper our traditional Service idealism with the realism of duty on the beat and in the section house. Charles Kingsley described one of his characters as " one of those men who possess almost every gift except the gift of the power to use them," a type which is all too familiar in every walk of life, and which in the police service fails singularly in the competition for individual promotion.

In the police officer, intellectual attainments are not so much of account as a knowledge and judgment of his fellow men, and his ability to lead, direct and guide their daily activities. That is why many policemen, with no more educational background than that provided in an elementary school, stride faster along the road to promotion than some who were fortunate to have enjoyed secondary education or

come from a public school. The former have concerned themselves, in their early police days, with the realities of the demands of police duty, well knowing that they must stand upon their own feet, with brains and energy pitted against their more expensively equipped competitors. Self-reliance is an asset which confers on such men an advantage over those who, for the first time in their lives, find themselves unaided. For both types the vital need is experience, reinforced by application and industry, gained as their police service extends from probation to promotion.

In defining the qualities of leadership there is no need to distinguish between the ranks of sergeant, inspector, superintendent or even the superior posts. Although in the English police no constable has yet carried in his staff pocket the baton of a future Commissioner of Police of the Metropolis, that unhappy fact has been rather the fault of the machinery of police authorities than the misfortune of those in the service. Most of the qualities necessary in a chief officer of police are also necessary in the police sergeant; if the latter lack those qualities the administration of the former will be defective. The success of any officer, of any rank or designation, can only be judged by results. In the case of the chief officer of police, the test of his leadership lies largely in his ability to select the right men for the several tasks which come within the sphere of his command. For this reason, police promotions, in the words of Regulation 27, are made "by selection"; not by seniority, not by competitive examination, but by selection.

An analysis of the qualifications in leadership which are expected of the sergeant will be useful to a continued examination of this subject.

Teaching and Learning in Leadership

The object of all police training is to teach the constable how to apply those principles upon which the police service has been founded, for the maintenance of order and the keeping of the peace, and to impart to him a knowledge of the laws which are enforced, and the duties which are carried out, by the police. This teaching is best done by example

and experience, and by fostering in the mind of the constable the value of discipline, physical fitness, intelligence, energy, and confidence in his superiors. Police duty is mainly carried out by, and indeed its success largely depends on, a careful decentralisation of command and execution of functions. For this reason, in law and in practice, the junior constable enjoys all the powers, privileges and duties of the senior officer, save in those cases where the Statute expressly provides for the exercise of powers to be limited to a chief or other senior officer of police.

Leadership in the police service then, as between sergeant and constable, depends on the development and exercise of simple and straightforward human qualities. A leader must have the confidence of the men whom he leads. This confidence can be gained only by commanding respect—respect for his determination and his ready acceptance of responsibility; for the clearness and simplicity of his orders and the firm way in which he insists that they shall be carried out; for his thorough knowledge of his professional duties and his ability and readiness to pass on that knowledge to subordinates; for his sense of justice and commonsense; for his indifference to personal danger and the readiness with which he shares the hardships of his men; for his keenness, energy, and habit of forethought; for his persistent good humour in face of difficulties; and for the obvious pride he takes in his section and division.

The sergeant who has the full confidence of his men has attained much. He has an instrument at hand capable of high achievement, and the spirit with which he is able to imbue it will carry it to success through the most difficult and hazardous tasks. Whatever demands he may make on his men will be willingly and cheerfully met. Wherever he goes his men will follow.

A police officer's first asset is to have confidence in himself. The ability to command, which is developed by actual experience in the command of men, includes readiness of judgment, which can be acquired only by sound experience on the beat and in personal contact with subordinates, built up by study and practice until it has come to be instinctive.

Confidence also begets initiative, which is the ability to determine when independent action is required, and the necessary self-confidence to take such action promptly and to assume responsibility for it, as well as the power to decentralise. The gift of being able to execute an order through a subordinate, without interfering with the personal responsibility of the subordinate, is one to be acquired by experience and practice, calling for tact and a knowledge of human nature so that the best can be got from each individual concerned.

The virtue most to be cultivated in carrying out routine beat and section duties is *energy*. To do nothing is to do wrong. In a section it is invariably to be noticed that efficiency varies with individuals. Some men are slow to grasp things but quick in action once the problem being dealt with has been understood and mastered. Others may be brilliant in reception, but unreliable in executing orders or in making tactful and discreet investigations. A superior officer's skill lies in his ability to make the most of his material. Some persons in authority soon become intolerant towards any subordinate who is unable to keep pace with their own fast-working mentality. Hence the need to practise the virtue of patience, without developing into the type which is content to let things slide.

In stimulating energy amongst subordinates, particularly in the police, where the energy demanded is both mental and physical, care is necessary to ensure that those who are steady and sure, but somewhat slow, are not quickened up at the expense of efficiency. The steady plodder who lacks brilliance has invariably many qualities which are of value in many phases of police duty, and particularly in the investigation of crime.

There should be nothing casual about any sergeant's job if he tries to do his duty conscientiously. So much can depend upon his attitude towards those who are under his control. He can inspire his section with enthusiasm, or alternatively breed discontent. To some, criticism is so often a matter of habit, so easy to offer, yet frequently so unintelligent and inept that the tendering of criticism produces more harm than good. The proneness of many people to indiscriminate fault-finding applies directly to the individual treatment of members of a police force. Dean Swift, in one of his essays, compared the faults of mankind with the weeds of the field. If destroyed and consumed on the place where they flourish, the weeds are more likely to enrich and improve the soil than if they had never sprung. He therefore concluded that, when pointed out and eliminated, faults serve the purpose of enriching the experience.

Then there is the tendency of those who, " drest in a little brief authority," use that authority in a destructive instead of a constructive direction. The humiliation of reproof which is unmerited, particularly if it be accompanied by a sneer, does great harm. More, it reacts against successful leadership, and induces distrust and damps enthusiasm. When people are obviously doing their best, trying as hard as they can to do justice to the work in hand, a word of encouragement and approval is preferable to an unearned fault-finding word. The critic who discerns nothing but faults discloses himself as undiscerning and lacking completely that most useful of police virtues, discriminating tact.

Leadership, like other subjects of training, cannot be taught successfully unless the teacher has the ability to get the measure of the student. Every policeman is, more or less, a student of his fellow men, than which there is no more absorbing a pastime. " Measure your man " is a useful maxim not only in games but in the game of life. The man who can most successfully measure both the physical and mental make-up of the man to whom he is speaking gains the advantage of the personal contact between the two. Moreover, he automatically commands the other's respect and attention, and emerges as the acknowledged and natural leader.

To be a good teacher, several qualities are necessary. Enthusiasm for the subject, and an obvious personal belief in its value and importance; sympathy with and personal interest in the men and an understanding of their individual outlook on the work of the Force; a clear idea of the lessons

which the instruction is designed to teach, and method in their exposition; knowledge of the subject; and the ability to discriminate in giving praise, where praise is due, criticism where censure is deserved, and the avoidance of any appearance of sarcasm.

Personal Example

The main duty of a commander is the selection of subordinates for particular tasks, and in the ability to supervise their execution. This well-worn military maxim applies with special emphasis to the police service. The personal example set by superiors is of far-reaching importance, particularly in the development of morale amongst young men at the stage when they leave the police training school and take up the initial duties on the beat and life in the section house, or at any rate in the atmosphere of a new job.

The moral qualities most necessary to be cultivated, and which can most easily be emulated rather than taught in the class-room, are self-control, self-respect, patriotism, loyalty, pride of race, pride of force, and a high sense of personal honour. The growth of these moral qualities will be fostered chiefly by environment; they are to be acquired mainly by the example of personal conduct and habits of those who are superior in service and in rank. The majority of recruits to the Police Service come from the elementary and secondary schools, and therefore from the homes of working-class people. It is frequently claimed by many, whose claims to be good judges are beyond question, that the best type of recruit to the police force is the lad from the countryside, whose upbringing has been in a clean, healthy and respectable home, and with perhaps not too wide a knowledge of humanity as it exists in the crowded town. The type is generally found to be receptive, intelligent, open-hearted, willing and courteous, having many of the qualities which are traditionally characteristic of the English yeoman. Not least, the most useful of these qualities is the manner in which the country lad shows, as a type, from which there must also be exceptions, that he is amenable to discipline, is responsive, courteous and scrupulously honest.

Discipline

Discipline, by means of which the tone of any organisation can alone be maintained, is the bedrock of all police duty. It is the ingrained habit of cheerful and unhesitating obedience to the orders of the superior, and is reflected in the confidence of those who issue orders in the ability and readiness of subordinates to carry them out. For the individual, discipline includes self-respect and its outward marks, cleanliness and a smart personal appearance; and for the force, division or section as the case may be, it implies " team-work " under the leadership of the captain of the team.

The foundation of discipline is drill. Hence the training for police recruits contains a considerable time devoted to drill, foot drill, squad drill and physical training. The police recruit begins his service by being taught to " stand at attention," which in itself is the key to the purpose for which drill was invented. Standing at attention secures the whole attention of a man to his commander, by requiring (*a*) absolute silence, (*b*) the body controlled and motionless, and (*c*) eager expectation of the word of command and instant readiness to obey it. When a squad or parade of men is in the position of " attention," the unit places itself at the unlimited disposal of its leader. In movements of drill, it adds to this the instant, unhesitating and exact obedience to the orders given.

Drill compels the habit of obedience, and stimulates, by combined and orderly and uniform movement, the pride which a man takes in himself and in the Force of which he is a member. Unless drill is carried out smartly these results will not be attained. It is not the time spent on drill but the quality of the movements which is important. The constable who aims at promotion to sergeant's rank will do well to gain experience as a drill instructor. Drill instructors must, of course, be carefully selected, but instructional experience promotes skill in the use of the eye and the ear, the two main channels through which instruction follows with the voice. The drill instructor must remember that drill, like all other forms of instruction, is learned in the sequence of (*a*) explanation, (*b*) demonstration, (*c*) execution, and (*d*) repetition. To

each phase must be devoted such time, and such clarity of exposition, that the individual in the squad reaches perfection in the movement being taught. By acting as a drill instructor the powers of observation are developed, and the power to use the voice, and thus to acquire self-assurance and control. Personal knowledge is of little avail unless a leader can impart his knowledge to his subordinates, and the parade ground gives special opportunities for the improvement of this essential quality.

A high standard of discipline is not to be sought in fault-finding. The persistent fault-finder is a severe liability; criticism to him is a habit, so easily acquired, but so often is it unintelligent and foolish that it produces more harm than good. Its effect on the individual subordinate varies according to his personality and temperament. But for everyone the effect is depressing. Yet criticism, which gets to the root of the fault immediately, and which is followed by advice which shows how to improve, or to avoid, the conduct which has fallen into error serves to stimulate both loyalty and enthusiasm. Many people contrive to spread a spirit of cheerfulness wherever they go, and in whatever company they join. Most men are imitative. Consciously or unconsciously they engage in the pastime of "follow my leader." The leader sets the pace. He creates a precedent which is followed by most of his subordinates; the man who is merely a follower has an easy time, free from the risks of initiative, and the hazards of experiment. The leader, the experimenter, shoulders all the anxiety in the process of trial and error, but his conduct impels respect and obedience.

Police duty calls for a combination of the team spirit and of individualistic enterprise. On the beat, every tour of duty brings its fresh surprise, even in the performance of a routine task. Many observers express astonishment at the imperturbability of the policeman as, notebook in hand, he takes stock of the situation, acts, and deals with the parties involved in the road accident or other (to him) commonplace occurrence. He has learned to anticipate events of this nature, and has mentally laid down for himself a disciplined and orderly course of conduct. Experience has proved this to be

important, and experience has brought its example and precedent which is now repeated, not merely in the commonplace road accident, but in the air-raid incident and the major catastrophes of war.

The qualities of leadership, then, which make a policeman a good sergeant, a sergeant a good inspector, and which help an inspector to aspire to the superior ranks in the Service, are those which are born of a high sense of loyalty and discipline, a widening outlook on human affairs, appreciation of the good and bad qualities in his fellow men, and the development of a human, cheerful and healthy temperament and personality.

The Colonial Police

The following appointments are announced by the Colonial Office:

GAMMAGE, A. L'E. (Assistant Inspector of Police) . . .	Inspector of Police, Nyasaland.
HOOK, M. A. W. (Sergeant, Palestine Police Force) . . .	Assistant Superintendent of Police, Cyprus.
JARRETT, R. C. C. (British Inspector of Police)	Assistant Superintendent of Police, Nigeria.
LE POIDEVIN, D. S. (Constable, Palestine Police Force) . .	Inspector of Police, Zanzibar.
MULLIN, F. W. M. (Assistant Superintendent of Police) .	District Superintendent of Police, British Guiana.
TENNANT, J. E. S. (Inspector of Police)	Assistant Superintendent of Police, Nyasaland.
THOMAS, L. A. (Senior Superintendent of Police) . .	Deputy Inspector-General of Police (Administration), Malaya.
WILLIS, J. A. (British Inspector of Police)	Assistant Superintendent of Police, Grade K, Palestine.
WILSON, A. E. (Assistant Superintendent of Police) . . .	Superintendent of Police, Nyasaland.
WYNNE, M. L. (Senior Superintendent of Police) . . .	Deputy Inspector General of Police (Crime and Politics), Malaya.

REVIEW

POLICE PRINCIPLES AND THE PROBLEM OF WAR. By CHARLES REITH. (Oxford University Press, 1940.) 7s. 6d. net.

THIS is a readable little book, the theme of it being that mankind will not keep the rules unless obliged to do so. In other words, that no tribe, state or nation will obey the laws imposed upon it, for its own benefit, by its rulers (whether monarchy or republic) unless those same laws are backed up by force. The city states of Ancient Greece disintegrated and faded away because they failed to supply the force necessary to back up the rules providing for united action against a common enemy. After the last war the League of Nations drew up rules which, had they been observed, would have kept the world at peace. Unhappily the League failed to make provision for compelling its members to obey those rules.

"In the international community," writes Mr. Reith, "as in England in past times, the existence of unenforceable laws inevitably created criminals and gangsters by the opportunities which the law's helplessness afforded them. The first of these . . . was Japan. . . . Japan was a member of the new community who had solemnly undertaken to observe community rules. Realising the weakness of the rules as being unenforceable . . . she broke the rules and seized Manchuria which was the property of her fellow-member, China. The victim appealed to the other members of the community to enforce the rules and protect her against aggression which, in the circumstances, was criminal. They hesitated, discussed the situation, and argued with one another. There was no force capable of acting. . . ." Mussolini, seeing that he could break the League's laws with impunity, invaded the country of his fellow-member Abyssinia. Again the League was powerless to enforce its own laws, and by its own shortcoming encouraged the third gangster, Hitler.

The remedy, when peace comes at last? Surely the obvious one: a police force energetically administered, with adequate powers to *compel* the members of the League to keep the rules. No army of occupation is necessary, nor indeed an armed force of any kind. The common-sense way to keep Europe, and the world, at peace would seem to be to provide an international police force, unarmed, each country being policed by its own nationals who are answerable to headquarters (presumably at Geneva). At least Mr. Reith thinks so. We hope he is right. But we would suggest, in addition, a prison (and not too comfortable a one at that) to which the would-be gangsters could be sent by the international tribunal set up to deal with them.