War Surgery of the Extremities

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PLASTER TECHNIQUE

BY

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Present conditions necessitate a reconsideration of some of the principles underlying the treatment in plaster-of-Paris of injuries to the limbs. There are significant differences in the principles involved in the treatment of different types of injury and at various stages of healing. For the purpose of this re-evaluation we may distinguish three main problems: (1) the treatment of closed fractures; (2) the treatment of major penetrating wounds of the limbs; (3) the treatment of certain more limited injuries to the soft parts, skin, tendons, joints, etc.

Closed Fractures

The object of plaster treatment is to obtain maintenance of reduction, of approximation of the fragments sufficient to secure rapid bony union, and at the same time maximum maintenance of function in the neighbouring joints, muscles, tendons, etc., compatible with the necessary splintage of the bones. Treatment does not consist in: reduction—immobilization—restoration of function, in that order. These phases are interlocked. Maintenance rather than restoration of function is the objective. This must, so far as possible, accompany all other treatment. The old rule that "the joints above and below the fracture must always be immobilized" has now so many exceptions to it that it has ceased to be of any value as a rule. Joint function may to a large extent be conserved by the continuous movement of the tendons which play over it. Wherever possible, however, full use of neighbouring joints is encouraged from the start.

The exact requirements with regard to inclusion of joints is dependent upon the specific site and character of the fracture. There still survives a belief that "rest" of itself has some mystical function in the production of healing. This can be misleading. It is essential to consider what tissues are involved and under what conditions healing takes place best in those tissues. All treatment should be based on a precise appreciation of the nature of the healing process and of all the factors which influence its speed and efficiency.

Major Penetrating Wounds of Limbs

Here the chief immediate objective is the prevention of infection; in particular, of severe spreading infection, septicaemia, gas gangrene, and tetanus. The role of a plaster cast applied to such a wound after full and careful wound excision, exploration, and drainage is threefold:

1. *Immobilization of all Tissues in the Limb.*—This includes all joints, muscles, tendons, bone, and even the skin.
2. *Protection of the Wound* against secondary infection (and against further injury while travelling).
3. *Even Pressure* to control oedema and limit granulation exuberance.

The most important function is that of immobilization, which plays a predominant part in the prevention and control of infection. It is necessary to leave only the tips of the fingers or toes accessible for inspection of circulation and with capacity to move them. As healing proceeds, and the danger of severe infection decreases, more movement may be allowed. When the wound is healed the condition will resemble that of a closed fracture. Where healing is delayed by local infection some kind of compromise is indicated. Immobilization of all tissues is essential in combating infection, but the function of muscles, tendons, and jonts cannot be ignored during the weeks and months which healing may take.

Injuries to Skin and Soft Parts

Here again initial treatment aims at the prevention of infection. Complete immobilization of all tissues of a limb may be necessary for a short time, perhaps only for a matter of days. Once the immediate danger of infection has been avoided, most injuries to skin, tendons, muscles, joints, etc., require carefully graded active movements during the ensuing period. The principles upon which immobilization is based change during treatment. Unless the exact pathological processes taking place are borne in mind at each stage of treatment, the routine use of plaster or of any other kind of splintage carries with it grave dangers of contracture, deformity, stiffness, and general loss of function. All of these complications must be regarded as avoidable.

General Considerations

Two other general aspects of the use of plaster require careful consideration. The question of the use of padded or unpadded plaster casts is closely linked with the danger of constriction effects.

The advantages of the unpadded skin-tight plaster are clear. Fit is exact, and pressure is evenly applied over the whole area. When padding is used it tends to become unevenly distributed. More plaster sores are due to friction than to pressure from an accurately moulded skin-tight cast. In the hands of those who have taken the trouble to learn how to use it, the skin-tight plaster is one of the major orthopaedic advances of recent years.

Certainly there are many occasions when local or general padding is desirable. It must be recognized, however, that constriction and interference with the circulation can occur, no matter how much padding is employed. Where there is no pre-existent vascular lesion the correct application of a skin-tight plaster is perfectly safe. Volkmann's ischaemic contracture has been seen where no splints of any kind were used. The dangers of circulatory damage can be avoided if certain precautions are taken. These involve: (1) routine elevation of the limb for twelve to twenty-four hours; (2) in closed fractures, early movements of toes or fingers; (3) careful observation of the fingers or toes with regard to mobility, colour, and temperature; (4) careful attention to all complaints of pain; (5) splitting of the plaster from top to bottom when there is any real doubt about the state of the circulation. The last precaution may be taken as a prophylactic in many types of cast. It is particularly easy to do, without interfering with security when the new pattern-plasters are used for forearm or whole-arm plasters (see below).

It should be borne in mind in this connexion that dried blood-soaked dressings can exert just as much pressure on an oedematous limb as can plaster. In addition, thrombophlebitis may result from pressure where wooden splints or plaster slabs are used without any tight encircling bandage whatever.

Finally it must be remembered that slight oedema, unless accompanied by cyanosis, coldness, numbness, severe pain, or pain on active or passive movement of the fingers or toes, is no indication for removal of the plaster. Certainly it does not require the piecemeal nibbling away of little bits which is so often seen. It is the limb that has swollen and not the plaster that has contracted. Elevation and active movements are the correct methods of dealing with such swelling.

Practical Aspects

Immobilization and Support during Application.—This is essential if an accurate fit is to be obtained without internal ridges. This is easy enough where Hawley tables, skeletal traction, and Böhler frames, etc., are available. Where they are not, it is often worth while to improvise rather than to depend solely upon the strength and endurance of assistants.

Time of Setting.—The whole plaster cast should set in one piece. Stratification makes for weakness. It can be avoided by rapid application and thorough rubbing in of each layer as it is applied. The time of setting can be delayed, where necessary, by the use of borax. "Cellona" plaster bandages set in 5 minutes, in tepid water. Warm water accelerates the setting

time. Borax, 1% (one tablespoonful to the quart), delays setting to 8 minutes; 1½%, to 15 minutes; 2%, to half an hour.

Removal of Plasters.—This is often a cause of considerable anxiety, discomfort, and unnecessary hard labour. In my experience the ordinary plaster shears are excellent, and most plasters can be removed with them rapidly and almost painlessly. The knack in using them can be acquired more easily if their mode of operation is understood (Fig. 1).

Types of Plaster.—Most limb injuries can be adequately splinted with circular plaster bandages, reinforced with slabs, plaster rope, external ridges, Cramer wire, or metal rods and strips. Nevertheless I believe the new pattern-plasters to be a great advance. Recently adopted by Trueta, these plasters can be rapidly prepared in advance from wide plaster rolls and special standard patterns.* Application is speedy. The method is economical. Good results can be obtained more uniformly in average hands. Where large numbers of casualties are being dealt with in a rush the advantage would appear to be overwhelming.

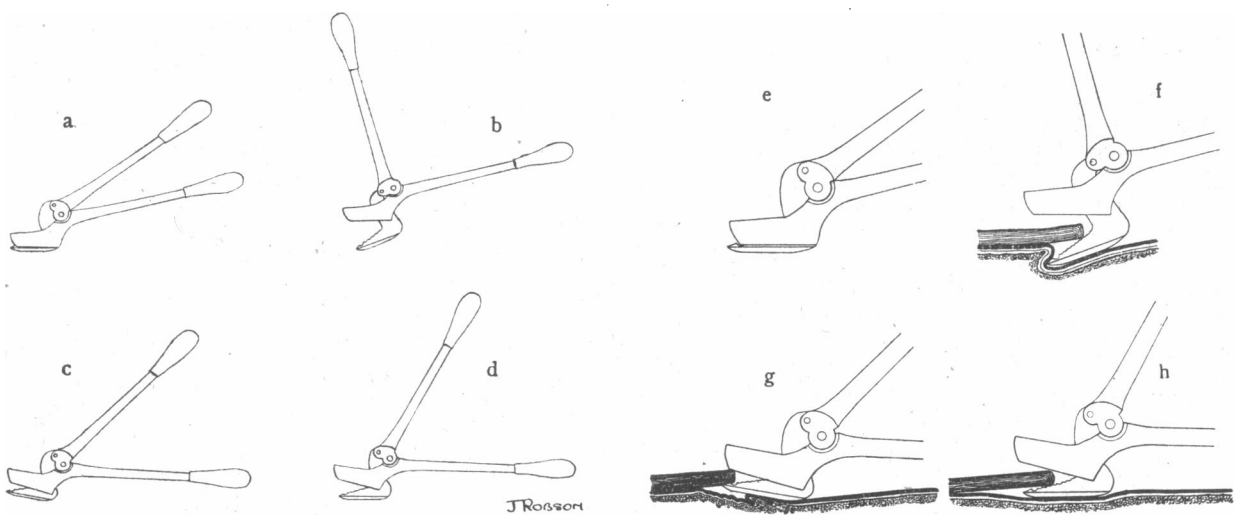

FIG. 1.—Diagram showing correct and incorrect use of plaster shears. a–d: Positions of handles. e–h: Magnified picture of jaws. a, e: Jaws closed. b, f: Point pressed into skin: danger of nipping skin. c, g: Heel pressing and bruising skin. d, h: Correct position for sliding and cutting.

Pressure Points.—Each main type of plaster gets its principal grip from certain key bony points. These are important in that they require special care in moulding or special protection with adhesive felt or rubber, which is more easily adapted if a cross is cut in the centre.

Weak Regions.—These require reinforcement. If they are not appreciated the whole cast will have to be made unnecessarily thick and heavy, with consequent waste of plaster.

Edges.—These are best rounded off with the fingers after reinforcement. Circular stockinet facilitates a neat finish, especially in the lower limb. The stockinet is rolled over when the plaster is nearly finished, and is fastened with an extra turn of plaster bandage. Where very accurate adaptation is essential, as in fractures of the carpal scaphoid, it is preferable to omit any such preliminary covering for the limb.

Soaking of Bandages.—Plaster bandages are placed in a basin of water with three to four inches unrolled. They are left in for 5 to 20 seconds, depending on size and thickness of the bandage. All bubbles are allowed to escape. The bandage is removed by lifting and gently squeezing the ends to expel excess water and conserve plaster.

Application.—Where any padding is used the first few turns are put on fairly firmly. In the skin-tight plaster they must be put on smoothly and evenly without tension. Moulding around bony points is done gently but firmly with the fingers and thenar eminences. One danger of manual support is that fingers tend to grip and so produce grooves which may result in sores. Plasters may only be supported with the flat hand. Each layer is rubbed over to secure cohesion. Slabs, ropes, ridges, etc., are added and incorporated as indicated.

Slabs.—These are made by running the bandage back and forth on a flat board either wet or dry. They must be smoothed out carefully before application. They are maintained in position by circular plaster bandages or previously soaked muslin bandage.

Plaster Rope.—This is made by twisting the unrolled wet plaster bandage into a rope of the required size and thickness. The rope is attached by a few extra turns of bandage.

Amputations.—It is worth mentioning here that plaster-of-Paris forms an excellent dressing for healing amputations, wounds, or as an immediate emergency dressing.

A few of the more important features of some useful types of plaster cast suitable for application in injuries of the extremities may profitably be described in brief.

Leg Plasters

It is difficult to hold a fractured leg in good position for plastering. Severe fractures below the knee are best supported by skeletal traction in some modification of the Böhler frame. Where there is no fracture liable to get displaced the Böhler frame is still preferable. Where no such apparatus is available improvisations are possible (Fig. 2). Weight-bearing below-knee casts must be carefully moulded around the tibial condyles, which take the main pressure. The plaster must not interfere with knee flexion. The foot is supported at a right-angle with certain exceptions only, and in the neutral position

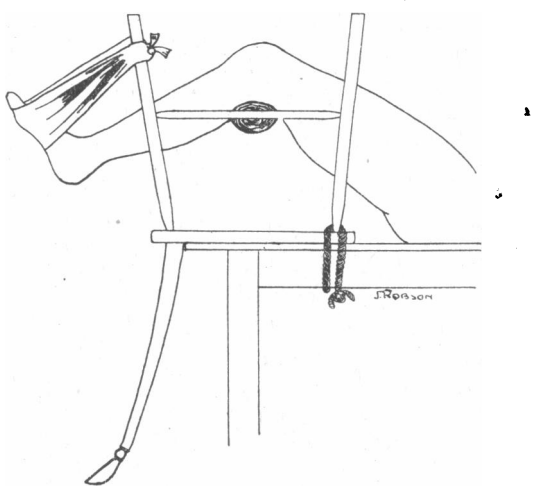

FIG. 2.—Use of chair as substitute for Böhler frame.

* Both the wide plaster and the standard patterns can be obtained from Messrs. T. J. Smith and Nephew, Ltd., of Hull, makers of "cellona."

rather than inversion. Moulding around malleoli, tendo Achillis, and heel requires care. Longitudinal and transverse arches are maintained by moulding while setting is taking place. A posterior slab forms the main support. Lateral cuts adapt it to the heel. Projection beyond the toes requires careful lateral strengthening to prevent transverse cracking (Fig. 3).

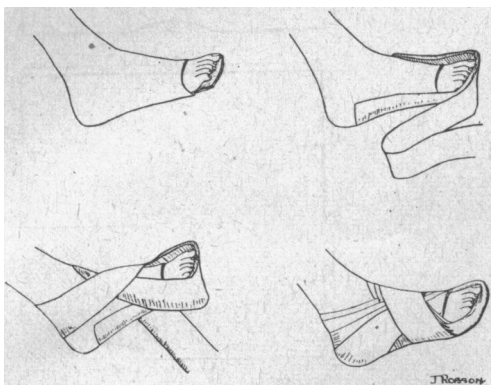

FIG. 3.—Diagram illustrating method of strengthening foot support in leg plaster.

Walking-irons are best applied when the cast has set—i.e., the next day. Care is needed in adjusting the position of the iron to give maximum stability without allowing the fore part of the plaster to scrape the ground. While irons are stronger, the rubber heel has many advantages, particularly in elderly patients or in those with an unsteady gait.

Hip Spica

Indications.—Immobilization of the leg below the knee can only be considered adequate for a severe wound if a hip spica is employed. For mid-thigh or hip injuries the double spica is essential. In many instances the double spica is preferable in any case; nursing is easier; and movement and transport are safer. The inter-thigh bar or rope adds greatly to stability. Opinions vary with regard to the level on the chest to which hip spicas need reach. We prefer to take them well over the lower ribs at the sides.

Support.—A hip spica is best applied on a special orthopaedic table. The sacrum is supported on a sacral rest and crutch pillar. The legs are suspended with the knees in flexion. A portable hip-rest may be substituted and the legs held by assistants.

Pressure Points.—The anterior superior iliac spines and the posterior aspect of the sacrum need special protection. Accurate moulding around the former provides the necessary immobilization of the pelvis.

Weak Regions.—Special strengthening is required across the groins, behind the knee, and in the postero-lateral region at the thigh-buttock junction.

Application.—A closely fitting stockinet covering is fixed in position with needle and thread over the padding on spines and sacrum. Overlapping slabs across the back are followed by a complete covering with plaster bandages down to the ankle. Slabs reinforce the weak regions and further bandages complete the main cast. As soon as setting begins the foot is freed and the foot plaster completed. With the knee supported, the knee-sling is released and the gaps trimmed and covered. When the plaster has set the patient is turned face downwards for trimming around the perineum to give adequate room for toilet purposes. The inside of the plaster is felt for ridges, which must be smoothed off. Room must be left over the abdomen. This may be ensured by preliminary insertion of a folded towel, which is removed later.

Nursing.—The prevention of plaster sores depends equally on accurate moulding and on good nursing. The plaster must be carefully dried under hot cradles or by exposure to the air for twenty-four hours. Pillows must not be allowed to support the shoulders so that the plaster cuts into the front of the chest. All complaints of pain and discomfort require immediate attention. If minor adjustments, trimming, aspirin, etc., provide no relief, the doctor in charge of the case must be consulted. Severe sores may be painful only during the first twenty-four hours. If they are not prevented, at least they must be diagnosed early. Sleep should be possible with a mild soporific.

Finger Plasters

Minor injuries to finger-tips may be treated in a plaster cap applied without other dressing (Fig. 4). When the whole finger requires immobilization a dry plaster bandage is applied, dipped in water, and moulded around the finger, the position of which is adjusted during setting (Figs. 4 and 5).

Injuries involving tendons require immobilization of forearm, wrist, and fingers. This may be obtained by using the narrow (1-inch) Cramer wire fixed to the outside of a forearm slab. Extensions of the fingers is also best attached to a Cramer wire extension from a forearm plaster.

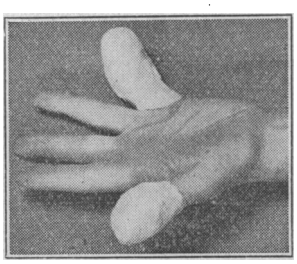

FIG. 4.—Finger plasters.

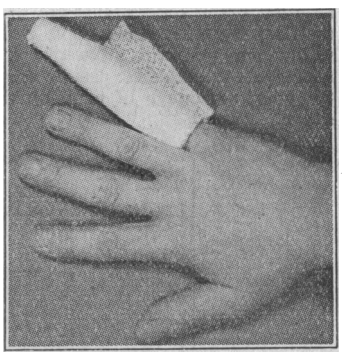

FIG. 5.—Application of the plasters.

Forearm Plasters

These may be applied in the form of a single slab cut out of wide cellona to the standard pattern (Fig. 6). This slab is about five layers in thickness, and is reinforced along the dorsum by interleaving with the surplus bits of plaster left over after cutting out. Application is simple. The edges can be turned back to leave a half-inch groove, which allows for swelling. The plaster is completed when the risk of swelling has passed.

A plaster suitable for extensive injury to the skin of forearm or wrist is illustrated in Fig. 7, A, B, and C. Complete immobilization is essential until the main risk of infection is past (A). The fingers can then be released and movements begun while pressure is maintained on the injured area (B). Later the elbow is freed and only the injured region is protected (C).

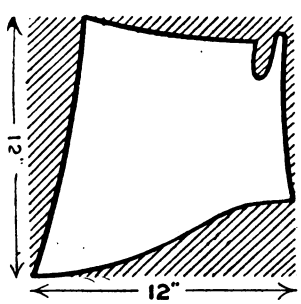

FIG. 6.—Pattern for forearm plaster.

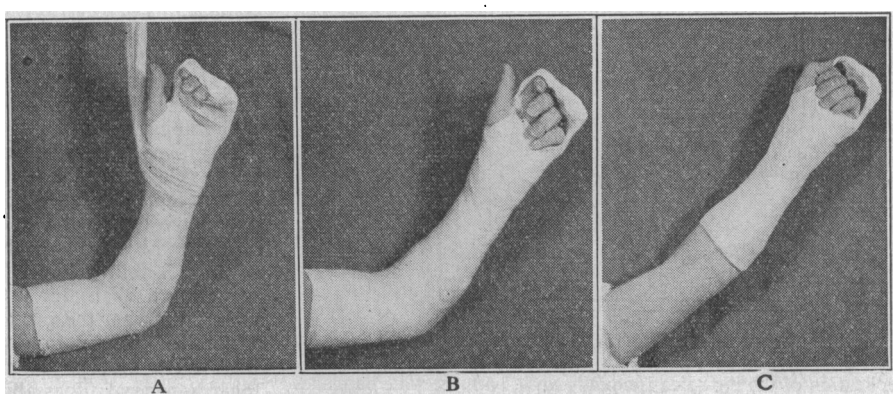

FIG. 7.—Graded mobilization (A, B, C).

Shoulder Spica

Here we believe that new pattern-plasters constitute the greatest advance, and only this technique will be described.

Preparations of Sections.—These are three in number—for front and back of the body, and for the arm. They are cut out in advance from six layers of wide cellona, using the standard patterns (Fig. 8).

These are satisfactory for a wide range of adult figures, but need some adjustment for children and out-sizes. The spare fragments are used for reinforcing weak regions.

Position.—When anaesthesia is essential the patient's head and shoulders are allowed to project beyond the edge of the table, with a narrow board attached to the table supporting the back. The head is held. When anaesthesia is not required the spica is applied with the patient sitting or standing. The arm is abducted at the shoulder to almost a right-angle. The elbow is flexed as found convenient. The arm projects forward at an angle of 45 degrees. The forearm is in mid-pronation, the wrist dorsiflexed.

Pressure Points.—The main weight is carried from the iliac crests. Protection is needed here, on the shoulder, and at the upper border of the opposite axilla.

Application.—The slabs for front and back are identical. They are dipped in water with 1½% borax, in a sink or deep trough. When wet they are dragged backwards and forwards over the edge of the sink to remove excess water, and then transferred to a table. There they are smoothed over carefully to remove all air bubbles. The slab is now taken by its upper edges and applied to the patient. With the aid of an assistant the lower part is firmly applied to the iliac crests. The upper part of the shoulder parts are then applied. The reverse half completes the body support, which is fixed in place by a few turns of previously wetted muslin bandage, while the arm section is similarly soaked, smoothed, and applied. The forearm is adjusted first. Lateral slits are made to fit the elbow. Finally the shoulder region is fitted. The axillary region is reinforced and the whole completed with a few plaster bandages. A support of wire or rope for the abducted arm is found to be unnecessary. This has the great advantage of enabling the patient to get his arm into a sleeve.

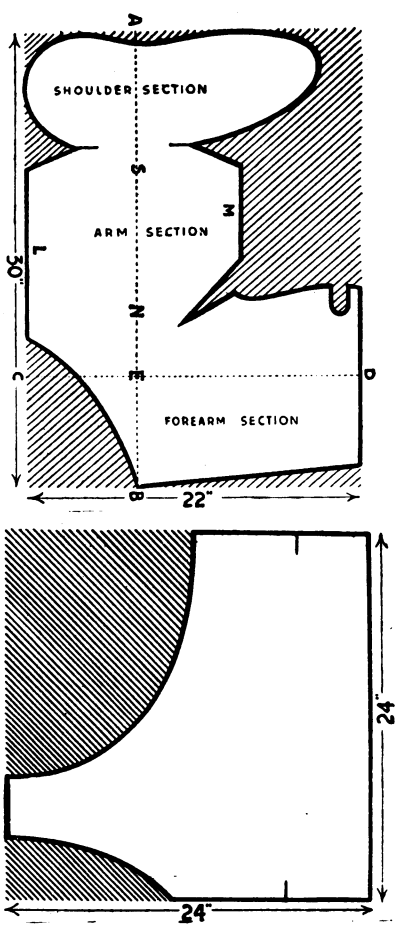

FIG. 8.—Pattern for shoulder spica.

Application of the hip spica is equally rapid with the wide bandages and special patterns. The mode of application is described in detail in a handbook recently issued by T. J. Smith and Nephew, Ltd., to which those interested are referred. The method is described here to introduce the principle. Various technical modifications will no doubt be required before its full value is determined in practice (Fig. 9).

Figs. 6, 8, and 9 are reprinted from Cellona Handbook, "The Preparation of Plaster Casts, with Special Reference to the Use of Wide Cellona Material."—January, 1941.

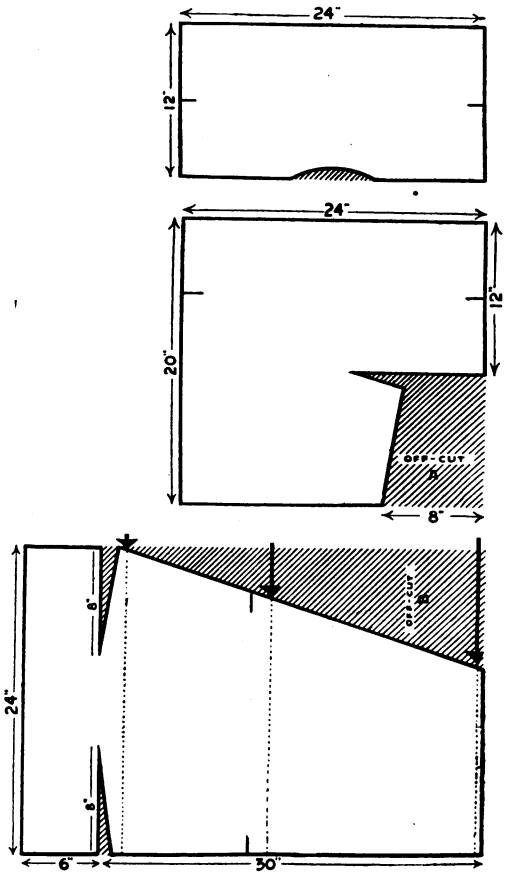

FIG. 9.—Pattern for hip spica.

My thanks are due to Messrs. J. Robson and E. V. Willmott for their co-operation in the production of diagrams and photographs.

THE IMPORTANCE OF NIGHT-VISION TESTS

BY

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In these days when special efforts are being made to lessen the number of road deaths and when statistics are being produced that give us the conditions under which accidents are most likely to occur, we find that twilight yields a high percentage. The ordinary motorist, when filling in his form of application for a driver's licence, must give some indication of what his day vision is, but nothing is said regarding his night vision. This is hardly surprising, because until recent times there has been no night-vision test which even the ophthalmologist could conveniently install in his consulting-room. The prospective driver tests himself, and if he can say that he is able to read a number-plate at so many yards' distance he is accepted so far as his sight is concerned. We know that he may have 6/6 vision and yet his fields be so contracted that he passes his friends in the street, and he may be even unaware of the disability himself. No one can imagine a company accepting a client for a £1,000 life policy on the usual terms merely on what the proposer had to say about his own health: a medical examination would be considered essential. Then why not a medical examination of the motorist, not only as regards general fitness but also as to hearing and night vision as well as day vision? In the former the risk is of money, in the latter of a life or lives, for he endangers not only his own life but the lives of others.

The Bishop Harman Test

In my experience most folk have a very erroneous idea of their visual ability in subdued light. If they have excellent vision in daylight they generally conclude that their night