1921.

QUEENSLAND.

KEDRON PARK RACECOURSE COMMISSION.

REPORT

AND

APPENDICES

OF

THE ROYAL COMMISSION

APPOINTED TO

Inquire into and Report upon the Safety of the Kedron Park Racecourse at Brisbane for Racing and Trotting purposes, and matters incidental thereto.

COMMISSIONER:
WILLIAM HARRIS, Esquire, Police Magistrate, Brisbane.

SECRETARY AND SHORTHAND WRITER:
L. P. WALLER.

PRESENTED TO BOTH HOUSES OF PARLIAMENT BY COMMAND.

BRISBANE:
BY AUTHORITY: ANTHONY JAMES CUMMING, GOVERNMENT PRINTER.
1921.

C. A. 5—1921.

Entered on Record by me in the Register of Patents, No. 14, page 212, this sixteenth day of December, A.D. one thousand nine hundred and twenty.

(Signed) P. J. McDERMOTT,
Under Secretary, Chief Secretary's Department.

COMMISSION.

GEORGE THE FIFTH, by the Grace of God, of the United Kingdom of Great Britain and Ireland, and of the British Dominions beyond the Seas, King, Defender of the Faith, and Emperor of India :—

To Our trusty and well-beloved WILLIAM HARRIS, Esquire, Police Magistrate, at Brisbane, in the State of Queensland, in the Commonwealth of Australia.

Greeting :

WHEREAS it is expedient that full and careful inquiry should be made into the safety of the Kedron Park Racecourse at Brisbane aforesaid for racing and trotting purposes and matters incidental thereto : Now, therefore, know ye that We, reposing a special trust and confidence in your zeal, knowledge, learning, industry, discretion, and ability, do by these presents, by and with the advice of Our Executive Council of Our said State, constitute and appoint you, the said WILLIAM HARRIS, from the twentieth day of December, One thousand nine hundred and twenty, to be Our Commissioner for the purpose of inquiring into the matter hereinbefore mentioned : And We do hereby require and enjoin you to make diligent inquiry into the matter aforesaid, and for that purpose to exercise all the powers conferred upon a Commission by "*The Official Inquiries Evidence Act of* 1910" : And We do further command and enjoin you to summon before you and to examine all such persons as may appear to you able to inform you concerning the premises, and to cause to be taken down in writing and recorded the evidence of the several witnesses that may appear before you, and such evidence, together with a full and faithful report touching the matter aforesaid, to transmit to the Chief Secretary of Our said State on or before the twenty-fourth day of January One thousand nine hundred and twenty-one or such further time as may be stated by Us in that behalf.

In testimony whereof, We have caused the Public Seal of Our said State to be hereunto affixed.

Witness Our Trusty and Well-beloved His Excellency The Right Honourable Sir MATTHEW NATHAN, Major on the Retired List of Our Corps of Royal Engineers, having the Brevet Rank of Lieutenant-Colonel in Our Army, Knight Grand Cross of Our Most Distinguished Order of St. Michael and St. George, Governor of Our State of Queensland and its Dependencies in the Commonwealth of Australia, at Government House, Brisbane, this sixteenth day of December in the year of Our Lord One thousand nine hundred and twenty, and in the eleventh year of Our Reign.

(Signed) MATTHEW NATHAN.

By His Excellency's Command,

(Signed) J. MULLAN.

1921.

QUEENSLAND.

ROYAL COMMISSION AS TO THE SAFETY OF THE KEDRON PARK RACECOURSE, BRISBANE.

REPORT.

To His Excellency the Right Honourable SIR MATTHEW NATHAN, Major on the Retired List of His Majesty's Corps of Royal Engineers, having the Brevet Rank of Lieutenant-Colonel in His Majesty's Army, Knight Grand Cross of the Most Distinguished Order of St. Michael and St. George, Governor of the State of Queensland and its Dependencies, in the Commonwealth of Australia.

MAY IT PLEASE YOUR EXCELLENCY,—

On the 18th December last, I received Your Excellency's Commission to inquire into and report upon the safety of the Kedron Park Racecourse at Brisbane for racing and trotting purposes, and matters incidental thereto.

I commenced the inquiry by a personal inspection of the course on the 20th December, whilst racing was in progress.

As the officials of the Kedron Park Racing Club and many of the jockeys and horse trainers were engaged in connection with race meetings either at Kedron Park or country centres during the Christmas holidays, I deferred the taking of evidence of witnesses until the New Year.

Sittings of the Commission for the purpose of taking evidence were held in the District Court Room at Brisbane on the 5th, 6th, 7th, 11th, 12th, 13th, and 14th January, and at the Police Court at Brisbane on the 8th February; and, in all, forty-three witnesses were examined.

The inquiry was held in public, and representatives of the Press were present during the taking of evidence.

Mr. P. J. O'Shea (Solicitor) appeared on behalf of the Kedron Park Racing Club, and the Owners' and Trainers' Association were represented by Mr. A. Bailey.

During the progress of my investigations I was at a great disadvantage by reason of the fact that no plan of the course was in existence. I therefore caused such a plan to be prepared by Mr. E. H. R. Greensill, Authorised and Railway Surveyor, showing the radii of the curves and other details. (Appendix 1.) This plan I found of the greatest assistance in arriving at my conclusions.

I visited the course on a second occasion on the 3rd January last, during the progress of a race meeting. I took up a position on the racing track between the 2 and 3 furlong posts, where I could view the horses negotiating the curves at that spot; and an accident occurred in my presence near the 2-furlong post.

A transcript of the shorthand notes of the evidence, together with the documentary exhibits, is attached to this Report.

DESCRIPTION OF THE COURSE.

The Kedron Park Racecourse is situated on Kedron Brook, near Kedron Park Road, on an area of 34 acres 3 roods 20 perches of freehold land in the Parishes of Enoggera and Kedron.

The racing track was laid out by Mr. J. B. Sharpe, a former owner of the land, who, it would appear, had no professional experience in such matters. He first consulted Mr. H. Raff, an Authorised Surveyor, who made suggestions regarding the laying-out of the track, but, as these suggestions did not meet with Mr. Sharpe's approval, or give him a track of the size he required, he disregarded them and—to use his own words—"just adopted what he thought he could get a 6-furlong course into." It is a right-hand track, 6 furlongs in length measured 3 feet from the inner rail, and has been used for horse-racing for a period of over ten years. The races which are now run upon it are either 5-furlong or 7¼-furlong races. There is a starting lane near the western corner for the 5-furlong races, and the 7¼ starting barrier is near the commencement of the straight. The track varies in width from 39 feet to 80 feet, the maximum width being at the winning post and the minimum width near the 3-furlong post. It is enclosed on the outer edge with a substantial fence, and on the inner edge with the usual rail.

The racing track is of an irregular shape, with a finishing straight of about 13 chains in length. There is a starting straight of nearly the same length for the 5-furlong races, the length of which is obtained by the assistance of the starting lane. The finishing straight is used as a starting straight for the 7¼-furlong races. In addition to the two straights mentioned there is a short straight of about 2½ chains on the north. The remainder of the track consists of curves varying in radius from 15 chains down to 3½ chains. The curves represent the curvature of the inner rail. There are three curves of only 3½ chains radius, one being at the western portion of the track, one at the north-eastern, and one at the eastern portion of the track. Those at the north-eastern and eastern portions have very slight batters—that is to say, the ground is slightly higher on the outside of the track than it is at the rail—the batters being 1 in 70 and 1 in 45 respectively. There is a fall of 1 in 506 in the approach to the one at the western portion, a fall of 1 in 242 in the approach to the one at the north-eastern, and a rise of 1 in 462 in the approach to the one at the eastern portion; but, generally, the track is nearly level. It consists of couch grass roots, alluvial soil, and sand, which appear to be suitable for the purpose. It is a firm track, and the "going" is good. The track is harrowed and watered when necessary, although it appears that clouds of dust arise at times from the racing horses, even though the track may have been plentifully watered the previous day.

Within the racing track there is a training track which is covered with sand; it appears to be well adapted for the purpose.

The trotting track is within the racing track. It is of an approximately uniform width, nearly 4 furlongs in circumference; of an almost ideal shape, being a parallelogram with the corners rounded off. The curves are of a nearly uniform radius of 3 chains 15 links, with a considerable batter (as indicated by the cross sections on the plan) varying from 1 in 45 to 1 in 25. This trotting track is composed of cinder, and is watered when necessary.

The remaining portion of the land outside the racing track is taken up by the Saddling Paddock, the St. Leger Paddock, and the usual racecourse conveniences.

Horse-racing meetings, which include one trotting event, are held weekly, and a trotting meeting monthly, all under the auspices of the Kedron Park Racing Club, which is a proprietary club. The racing is controlled by Mr. E. J. Lawrence (Manager) and the usual staff of officials.

The profits derived from the racing and trotting meetings are said by the Manager to go to Mr. Frederick Thomas, of St. Kilda, Melbourne, who, according to the records of the Real Property Office, is the registered proprietor of the land.

TIME RECORDS.

I have been supplied with time records of all races run on the horse-racing track from 6th July, 1920, to 30th December, 1920. The average time of seventy-nine of the $7\frac{1}{4}$-furlong races works out at 1 minute 34·033 seconds, showing an average rate of speed of 34·7 miles per hour. The fastest time of those seventy-nine races was 1 minute $32\frac{1}{5}$ seconds, or at the rate of 35·39 miles per hour. The average time of 124 5-furlong races was 1 minute 4·05 seconds, equal to a speed of 35·28 miles per hour. The fastest of those 124 races was 1 minute $2\frac{2}{5}$ seconds, equal to a speed of 36·05 miles per hour. The approximate average on that course may therefore be taken to be 35 miles per hour.

It did not appear to be necessary to obtain such exact details of the time of the trotting races, but the average speed is, approximately, two-thirds of that given above.

LIMITATION OF FIELDS.

There does not appear to have been any fixed limit to the number of starters on either the racing track or trotting track. The practice has been to run in divisions when necessary. On the trotting track the fields consist of trotting horses (saddle) and trotting horses with gigs. Some of the horses are hoppled. They are handicapped by yards, not by seconds, and consequently start on different marks.

During the last six years the number of starters on the horse-racing track has been as follows:—

1915	2,654
1916	2,806
1917	2,837
1918	1,331
1919	3,025
1920	3,651

ACCIDENTS.

I found it impracticable to ascertain what accidents have occurred on the racing track from its inception to the present time, so I have confined my inquiries in that direction to the last three and a-half years. During that time the number of mounts has been about 9,500. I am not satisfied that I have obtained a record of all the accidents that occurred during that period, as no record has been kept of those in which the jockey sustained no injury;

but from the evidence given before me I have gathered more or less particulars of twenty-three accidents which occurred within that period during racing, three of which proved fatal. So far as these figures afford an average, they show one accident to about 400 mounts, and one fatal accident in about 3,000 mounts. It is only fair to point out, however, that there has been no other fatal accident on this racing track from its inception, during which time there have been probably over 20,000 mounts.

On examining the evidence relating to the locality of the twenty-three accidents which occurred during the last three and a-half years, I find that sixteen—that is, approximately, 70 per cent.—occurred on or in close proximity to one or other of the three curves of 3½ chains radius; nine of them occurred at or near the north-eastern curve of 3½ chains radius. Not all of these accidents caused injury to the riders. Nearly all the serious accidents occurred at or near the north-eastern 3½-chain curve.

I endeavoured to ascertain from the various witnesses the cause of these accidents. Generally speaking, the witnesses concerned in the racing do not attribute these accidents to the shape or condition of the track. Some of them somewhat hesitatingly admitted that the sharp curves were a disadvantage, but still asserted that the course was safe. Some jockeys gave evidence of having ridden a very large number of races without accident.

It is asserted by the officials, and assented to by the jockeys, that the jockeys take undue risks in fighting for positions.

The evidence of Mr. McGarrigal, the official starter, although not admitting that these curves are dangerous, shows that the Manager (Mr. Lawrence) was frequently warning the boys going out, and often gave him (Mr. McGarrigal) instructions to impart to the boys at the starting post a warning "to be careful in taking those turns, and ride fairly"; thus, in substance, recognising that danger existed.

The fact that so large a proportion of the accidents occurred in the vicinity of the sharp curves, together with the fact that the management found it necessary to frequently warn the boys to be careful in taking those turns, gives rise to a strong presumption that those sharp curves are unsafe, and that jockeys riding on them have to take a risk.

Mr. McGill, who has had a wide experience as a rider and trainer, says:—

> "If there are eight or ten horses in a race a boy wants to try and get up on the inside. If he goes round a field the owners won't have him; he must take a risk. If he doesn't take a risk he will soon be dropped; the owner doesn't want him."

This result of Mr. McGill's experience indicates that any caution or warning given to the jockeys is likely to be ineffective where dangerous conditions exist, and is of itself not sufficient precaution against unsafe conditions.

I have endeavoured to ascertain if any of the accidents were contributed to by large fields. The opinions of the various witnesses examined, as to what would be a safe limit, vary considerably. It has been the practice to run the races in divisions, at the discretion of the management, and so far as I can ascertain that discretion has been prudently exercised.

There have been a few accidents on the trotting track, which, as far as I have been able to ascertain, were not attributable to any fault of the track or the management.

AS TO THE SAFETY OF THE COURSE.

The presumption that has arisen on the evidence that the sharp curves are unsafe has caused me to make careful inquiries as to the effect of curves on horse-racing tracks. I have received information as to racing tracks in other States, from the Victorian Racing Club, the Australian Jockey Club, the Western Australian Turf Club, the New South Wales Trotting Club, Limited, the Under Secretary, Chief Secretary's Department, New South Wales, and more especially from Mr. John Weingarth of Sydney—who, as President of the Institution of Surveyors, New South Wales, at a meeting of that institution read a paper on "The Formation of Racecourses," which appears in the Journal of the Institution of 31st March, 1915, a copy of which is appended to this Report. (Appendix 3.)

I also addressed questions to many of the witnesses examined by me, and finally called as a witness on this point Mr. George Phillips, an Authorised Surveyor and Civil Engineer of wide experience.

Besides his oral evidence, Mr. Phillips has furnished me with a Report (Appendix 2) in which he has made observations on the plan of the course, with deductions, based on mathematical reasoning, of the unsafety of these particular curves.

Mr. Weingarth, in his paper to which I have already referred, states :—

> "From my experience I am satisfied that there should not be a curve of less than 5 chains radius, and that the curve leading into the finishing straight should not be less than 6 chains radius. I have heard of a course having been laid out with curves of 3½ chains radius so as to get the required length of 6 furlongs, and the track was registered by the Government. In my opinion the curve is absolutely dangerous. Of course, a very steep batter across the track will help to minimise the danger, but the risk is very great."

In the State of New South Wales provision has been made in "*The Gaming and Betting Act of* 1912" restricting the number of race meetings and the licensing of racecourses in that State, also prohibiting the holding of any race meeting for horse-racing or pony racing on any racecourse of less than 6 furlongs in circumference ; but as the Act itself does not restrict the radius of curves, I inquired of the New South Wales authorities as to the minimum curve sanctioned by the present practice in that State for racing horses other than ponies or trotting, to which I received a reply from the Under Secretary, Chief Secretary's Department, as follows :—

> "No minimum curve fixed by Department. When question is raised it is held by Department that no curve should be less than 5 chains radius, and the curve leading into the straight not less than 6 chains."

In response to an inquiry, the Secretary of the Australian Jockey Club wrote :—

> "I understand that no racecourse will be licensed in this State when the curves, other than the one into the straight, were less than 5 chains radius. The one into the straight should not be less than 6 chains. At Randwick the curve into the straight is 8 chains radius, and this is considered by some owners and trainers to be sharper than it should be. However, within the last ten years we have had no accidents which could be attributed to the sharpness of any of the curves."

In response to a further inquiry, the Secretary of that Club advised me as follows :—

> "Randwick racecourse is raised very little on the outside ; the batter on the curve leading into the straight, where the track is 100 feet wide, is only 1·92 feet."

In response to an inquiry, the Secretary of the Victorian Racing Club wrote :—

> "*Re* racing curves, the subject is one to which little attention has been given anywhere, but which is of the greatest importance so far as good racing and the safety of the jockey is concerned. Nearly every course is a problem in itself, but so much depends on aspect and contour that no general rule can be laid down.
>
> "Most racecourse curves, as far as my experience goes, are laid out by rule of thumb and are bad. Being an old surveyor I have paid considerable attention to the matter. Few surveyors that I know have studied the question. The true co-tangental curve that looks so well on paper is sometimes the worst curve to race on. Racing curves should be elliptic. That is, speaking to a layman, the curve to commence with should be as great a radius as possible and should be gently coaxed in to curves of lesser radius ; when, towards the latter part of a turn, a very small radius would be perfectly safe, whereas at the commencement it would not only be dangerous but a horse could not be kept on the rail.
>
> "The question of velocity must be also taken into account and the position of the curve with regard to the starting points and winning post.
>
> "The best person to refer to locally would, I think, be a Railway Engineer who has had experience in laying out railway curves."

The Secretary of the Western Australian Turf Club wrote as follows :—

> "The 'lay out' depends a great deal on the acreage of the land that is being dealt with. The sharpest turn on this Club's course is on a 7-chain radius, which has been found quite satisfactory.
>
> "From outside inquiries I am told that, unless unavoidable, a smaller radius is not advisable for racehorses, but ponies can race on a small radius curve with perfect safety."

In the well known publication *Rough's Guide to the Turf*, a brief description is given of a number of large racecourses in England. In that description, "sweeping curves" and "easy curves" are frequently spoken of.

There appears to be a great lack of knowledge on the part of people connected with horse-racing with respect to what effect (if any) the existence of a curve has on the safety of racing at high speeds, and as to what provision should be made for counteracting the effect of curves. Racecourses are usually laid out by qualified land surveyors, whose skill there is no reason to doubt as far as the surveying and general planning are concerned, but the effect of sharp curves on the safety of racing is sometimes overlooked. Should any legislation be contemplated I humbly advise that this aspect of the matter should be given consideration.

It appears to have been the practice on many racecourses in other States to provide batters to minimise the effect of curves. Such batters appear to be almost universal with respect to other kinds of racing, on tracks with curves of small radius. Many of the riders and racing officials who gave evidence before me questioned the necessity or the wisdom of providing such batters. Some even appeared to ridicule the idea; others suggested that it might cause the horses to crowd in on the rail, possibly adding to the risk instead of minimising it.

There is one outstanding fact in this connection ; that is, that the well known racecourse at Randwick has a curve of 8 chains radius leading into the straight, with a batter of 1 in 50, and in ten years there have been no accidents which (according to the Secretary) could be attributed to the sharpness of the curve, although that curve is considered by some owners and trainers to be sharper than it should be.

Mr. Weingarth, who has a wide experience in such matters, in his Paper (Appendix 3) says :—

> "The batter has the effect of horses keeping parallel with the inner rail; where there is no batter the horses are inclined to run off, notwithstanding the pressure on the bit, and some horses are more prone to it than others. Should the inside horse of a bunch run off ever so little, he will collide with another horse. Also, when there is no batter, the near legs have not sufficient support, the horse is going round a turn, the jockey leaning towards the rail and is pulling the off rein, and the whole weight is on the off legs, so that if one of the legs is touched by another's legs, it is apt to bring him down."

Mr. Phillips, in his written observations on the plan, has made calculations and prepared tables of the degree of batter or banking-up which would be required to counterbalance the effect of the curves with respect to races run at the average speed at which they have been run upon the Kedron Park racing track during a period of six months. The amount or degree of batter or banking-up shown by the tables to be necessary for the existing sharp curves on the Kedron Park racing track is so great that its adoption might give rise to other dangers. Mr. Phillips himself says it is not permissible, and I should hesitate to recommend that it should be adopted on the curves in question.

The deductions drawn by Mr. Phillips from the plan are quite in accord with the facts and reasoning set out in Mr. Weingarth's Paper.

The angle at which a horse may travel on a curve is well illustrated by the photograph appended hereto. (Appendix 4.)

My investigations as a whole show that, although the danger arising from curves may be minimised by proper batters, curves of a small radius such as 3½ chains would still be dangerous on tracks used for horse-racing.

FINDINGS.

From a consideration of the matters herein referred to I have come to the following conclusions :—

I am unable to find any ground for a presumption that any of the accidents on the Kedron Park Racecourse have been attributable to large fields, either on the trotting track or on the horse-racing track.

There is no evidence of any unsafety in the design, construction, or maintenance of, or otherwise in connection with, the trotting track.

I find that the curves of 3½-chains radius on the horse-racing track are unsafe.

I find that the curve of 3½-chains radius at the north-eastern portion of that track is especially unsafe by reason of the approach thereto being a fairly straight run on a falling grade, along which the jockeys rush to get positions.

I find that other curves of less than 7-chains radius on that track are of doubtful safety for horse-racing, uncompensated as they are by sufficient batters.

I am of the opinion from my investigations, that curves of less than 5-chains radius are in any circumstances more or less unsafe for horse-racing, as distinguished from pony racing or trotting.

I find that in all other respects the Kedron Park Racecourse—its conditions, surroundings, and management—is safe for racing and trotting purposes and matters incidental thereto.

I am of the opinion that the management by the officials controlling the racing has been excellent.

SUGGESTIONS.

Mr. Phillips, on page 18 of Appendix 2 and on the blue print (Ex. 15),* has demonstrated how the racing track in question could be provided with curves of a 5-chain radius, with a curve of 6-chains radius into the straight. This would entail the reduction of the length of the track by 6 chains, and would also necessitate an alteration of the trotting track. It would permit of 5-furlong and 1-mile races being held, in lieu of 5-furlong and 7¼-furlong races as at present.

It is clear, however, from the general tenor of Mr. Phillips's evidence, that even 5-chain radius curves are less than he would recommend, even with a considerable batter or banking-up. This is apparent from the concluding paragraph of his Report, which reads as follows :—

> " For those upon whom the duty of laying out racing tracks for horses (not ponies) may devolve, the safe rule is as follows :—If the centrifugal force developed on any curve demands a batter steeper than 1 in 5 as a maximum, that curve is not only dangerous but incurably so, and should be discarded. This rule, if strictly adhered to, would, at Kedron Park Racecourse, exclude any curve of less radius than 6 chains ; *vide* Table on page 16."

Mr. Weingarth, in his letter of 2nd February instant (part of Exhibit 14), has also made a suggestion for altering the curves and providing compensating batters which, he states, would *make the track safe for ponies.*

It is not within the scope of my Commission to recommend either of these, or any other design or scheme ; but I may say that broadly the result of my inquiries is that any curve of less than 8 chains radius is undesirable on a racing track for galloping horses, and if permitted at all should be provided with a compensating batter the full width of the track ; and care should be taken that the top dressing does not flatten the track.

CONCLUSION.

In conclusion, I desire to cordially acknowledge the courtesy with which Mr. E. J. Lawrence (Manager) and officials of the Kedron Park Racing Club have facilitated my investigations. I desire also to acknowledge my obligations to Mr. John Weingarth, L.S. (Sydney), Mr. George Phillips, M.I.C.E., Mr. E. H. R. Greensill and other officers of the various Departments of the Public Service, and others for valuable assistance rendered ; and to record my appreciation of the zeal and efficiency with which Mr. L. P. Waller has discharged his duties as Secretary, and his accuracy as Shorthand Writer to the Commission.

I have the honour to be,

Your Excellency's obedient Servant,

WM. HARRIS,

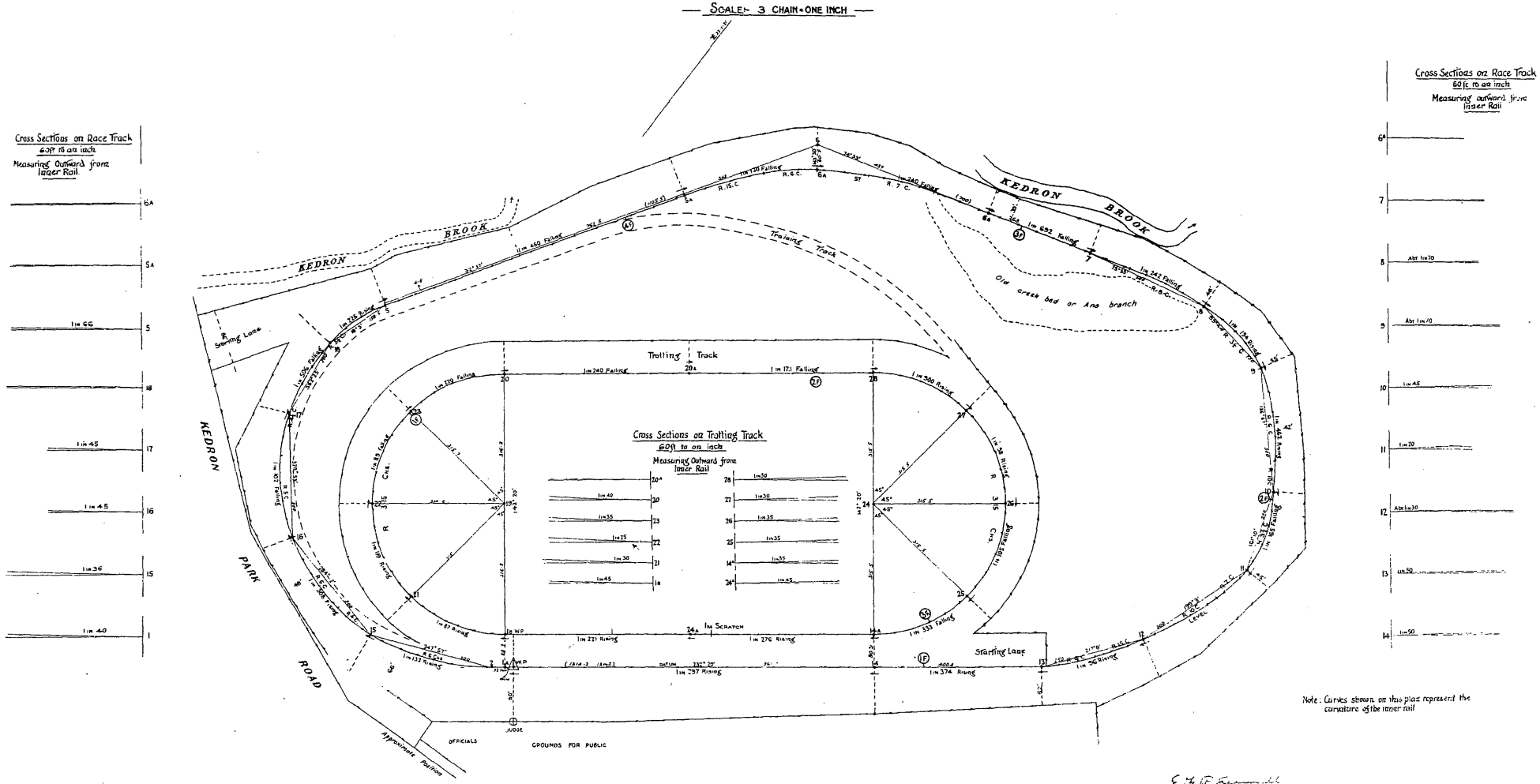
Commissioner.

* Not printed.

(Appendix I.)

PLAN OF KEDRON PARK RACE TRACKS

SCALE:- 3 CHAIN = ONE INCH



APPENDIX II.

Hall Street, Alderley,
31st January, 1921.

W. Harris, Esq.,
Police Magistrate, Brisbane.

KEDRON PARK RACECOURSE INQUIRY.

Dear Sir,—With reference to your inquiry *re* the lay-out of Kedron Park Racecourse, as revealed by Mr. E. H. R. Greensill's recent survey, copy of whose plan of the course and grounds you were good enough to lend me for the purpose, I beg to report as follows :—

The proper design and judicious lay-out of racecourses does not appear, so far as I am aware, to have received much scientific attention. I have laid out several racecourses, but all were on very flat ground with ample room for very easy curves. I designed the cycle track at the Woolloongabba Cricket Ground in 1904, and, in that instance, I had very carefully to consider the question of batter to counteract the effect of centrifugal force.

The only printed contributions on the subject I have met with are those you lent me. They are by Mr. J. Weingarth, Licensed Surveyor, of New South Wales, who is a recognised authority on the lay-out of racecourses in that State. They were printed in the "Surveyor," the official journal of the Institution of Surveyors of New South Wales, as follows :—

(*a*) "The Laying-out of Racing Tracks," 6th October, 1892 ;

(*b*) "Formation of Racecourses," 31st March, 1915.

Both contributions by Mr. Weingarth are instructive and practical, but neither of them deal mathematically with the vital aspects of speed and the correct batter to counteract the centrifugal force developed thereby.

I may here remark that the centrifugal force, and consequently the batter, varies directly as (*a*) the weight of horse and rider, (*b*) the radius of the curve, and (*c*) as the square of the velocity in feet per second. Of the three factors I have mentioned, it will be seen that speed is far and away the most important. For example : At 20 feet per second the value of velocity in the equation = 400 ; at 40 feet per second the value of velocity in the equation is 1,600 ; and at 50 feet per second (quite a common speed on the Kedron Park Racecourse) the value of velocity in the equation from which the centrifugal force is determined is 2,500 or more than six (6) times the value of velocity at 20 feet per second, and more than 50 per cent. greater than at 40 feet per second.

The centrifugal force for any speed, any weight, and any curve, is determined as follows :—

Let C = the centrifugal force in pounds.

Let W = the weight in pounds.

Let R = the radius of the curve in feet.

Let V = the velocity in feet per second.

Let g = the acceleration of gravity = 32·2 feet per second.

Then $\frac{C = W V^2}{g R}$ equation (1).

The appropriate batter = $\frac{W}{C}$ equation (2).

I shall endeavour to avoid technicalities, merely stating the conclusions I have arrived at after careful mathematical investigation.

The following data have been of great assistance :—

1. Mr. Greensill's plan of the course supplied to me by you.

2. The Official Time Records of both the 5-furlong and 7¼-furlong races between 6th July and 30th December, 1920, supplied to me by you.

3. The declared weights for the races to be held this day, taken from the "Telegraph" of 27th instant, for both the 5-furlong and the 7¼-furlong races, as follows :—

(*a*) Average weight for 58 horses in the 5-furlong = 130 pounds.

(*b*) Average weight for 36 horses in the 7¼-furlong = 128 pounds.

The average weights were worked out by me and carefully checked.

DESCRIPTION OF THE 5-FURLONG COURSE.

The following description is taken from Mr. Greensill's plan :—

Start on 3·5 ch. curve	for	1 chain 65 links, rising 1 in 225.
Straight	,,	7 chains 60 links, falling 1 in 460.
15-ch. curve	,,	2 chains 00 links, falling 1 in 130.
6-ch. curve	,,	2 chains 25 links, falling 1 in 130.
Straight	,,	0 chain 80 links, falling 1 in 130.
7-ch. curve	,,	2 chains 15 links, falling 1 in 240.
Straight	,,	4 chains 75 links falling 1 in 692.
8-ch. curve	,,	2 chains 60 links, falling 1 in 242.
*a*3·5-ch. curve	,,	2 chains 00 links, rising 1 in 194.
6-ch. curve	,,	3 chains 10 links, rising 1 in 462.
*b*3·5-ch. curve	,,	2 chains 00 links, rising 1 in 165.
7-ch. curve	,,	2 chains 00 links, level.
10 ch. curve	,,	2 chains 00 links, level.
15-ch. curve	,,	2 chains 50 links, rising 1 in 96.
6-ch. curve	,,	
Straight to winning-post for ...	,,	12 chains 60 links, rising 1 in 374 / 1 in 297
Total		50 chains 00 links = 5 furlongs.

NOTE.—The most dangerous points on the above course are as follow :—

(*a*) At the junction of the 8-chain and 3·5-chain curves, where the gradients change from 1 in 242 falling to 1 in 194 rising.

(*b*) At the junction of the 6-chain and 3·5-chain curves, where the gradients change from 1 in 462 rising to 1 in 165 falling.

THE 7¼-FURLONG COURSE.

As there is nothing to indicate the starting-point of this course, I will omit the description in detail, but I may mention that it must comprise the following curves in addition to those described above for the 5-furlong course :—

6-ch. curve for 3·10 ch. on 1 in 132 ; 4-ch. curve for 1 ch. on 1 in 308 ; 6-ch. curve for 2 ch. 10 lk. on 1 in 308 ; 5-ch. curve for 2 ch. on 1 in 102 ; 4·5-ch. curve for 2·10 ch. on 1 in 102 ; and 3·5 ch. curve for 1 ch. to the starting-point of the 5-furlong course, on 1 in 506.

The danger points on the 5-furlong course are, of course, common to the 7¼-furlong course, with the addition of the 3·5 curve last mentioned, which has a total length of 2·65 chains, partly on a falling and partly on a rising gradient. Change of gradient on such a sharp curve is very undesirable.

WEIGHTS.

The only reference I can find to the weight of horses is in "The Works' Manager's Handbook," by W. S. Hutton, second edition, 1885, where, at page 5, he says :—

"The average weight of a cart-horse is 13 cwt. ; a cob, 7 cwt. ; a mule, 6 cwt."

I have seen many medium and small mules ; also a few very large mules as much as 17 hands in height.

As the average height of horses running on the Kedron Park course is probably about 15·2 —say 62 inches over withers, I think I may safely assume an average weight for horses, undressed, of 6 cwt., or 672 pounds. I have already shown that the average weight allotted to horses for this day's 5 furlong races is 130 lb., and for the 7¼-furlong races 128 lb. I propose, therefore, to assume a total average weight of horse and rider, for both distances, of 800 lb. Tall and stout horses might exceed that weight by 100 or more pounds, whilst weedy horses might not exceed 700 lb. with light weight up.

PACE.

As already explained, pace, or velocity, is the most important factor in determining the lay-out of a racecourse.

I have very carefully analysed the official time records of 124 5-furlong races, and of 79 7¼-furlong races, with the following results :—

FIVE (5) FURLONG RACES (6 JULY TO 30 DECEMBER, 1920).

(*a*) Fastest time (on 29th July, 1920), 1 min. 2⅖ sec. = 52·8846 feet per second.

(*b*) Average time of 124 races = 1 min. 4·05 sec. = 51·5225 feet per second.

(*c*) Slowest time (on 30th August, 1920) = 1 min. 7 sec. = 49·254 feet per second.

The fastest time of 1 min. $2\frac{2}{5}$ sec. occurred twice on 29th July, 1920, and once on 13th September, 1920.

On six other occasions the time was less than 1 min. 3 sec.

On seven other occasions the time was exactly 1 min. 3 sec.

It will be seen, therefore, that out of a total of 124 races the time only varied between 1 min. 2·4 sec. and 1 min. 3 sec. on 16 occasions.

The average of those 16 races works out as 1 min. 2·8 seconds.

Of the slower times only seven (7) exceeded 1 min. 5 sec., exclusive of the slowest, 1 min. 7 sec.

The average time of all races of 1 min. 5 sec. and over amounts to 1 min. 5·325 sec. for 16 separate races.

The slower times are probably accounted for by wet weather, when extra caution was necessary.

According to the "*Encyclopædia Britannica*," 10th edition, Vol. xxix., page 332, the fastest time in England for a 5-furlong race was run at Epsom on 19th April, 1898, by "Othery" in $57\frac{1}{5}$ sec. = 57·7 feet per second.

The Epsom course (on which the Derby is run) is described as "by no means a good one, in consequence of the abrupt turn at Tattenham Corner; and the severe descent after this turn is made is also held to be a disadvantage"—Vide page 329. Probably the 5-furlong course over which "Othery" run did not include the objectionable turn and descent.

Bearing in mind the fact that there are two curves of 3·5 chains radius, the first of which commences $22\frac{1}{2}$ chains from the starting-point, whilst the second curve ends at about 20 chains from the winning-post, with no batter to speak of, I think the running times for the 5-furlong races are very creditable to both horses and jockeys. It is evident, also, that it is in the neighbourhood of the two 3·5 chain curves that the most strenuous efforts are made by the jockeys to secure favourable positions, without which, when three-fifths of the distance is covered, it would be difficult for the speediest horse to secure a race of 5 furlongs, more especially on a course which is practically flat transversely. With suitable batter from the commencement of the 3·5 chain curves to the end of the 6-chain curve leading into the straight, a speedy horse, which had failed to secure a good position at the first sharp turn, would have a much better chance of passing his competitors.

It may be claimed, of course, that such good running reflects credit on the course as well as on the horses and jockeys. This aspect of the subject will be considered under the heading of "Centrifugal force and Batter."

$7\frac{1}{4}$ FURLONG RACES (6 JULY TO 30 DECEMBER, 1920).

(*a*) Fastest time (on 13th December, 1920) = 1 min. $32\frac{1}{5}$ sec. = 51·9 feet per second.

(*b*) Average time of 79 races = 1 min. 34·033 sec. = 50·886 feet per second.

(*c*) Slowest time (on 6th July, and again on 30th August) = 1 min. 37 sec. = 49·33 feet per second.

Considering the extra distance of $2\frac{1}{4}$ furlongs (495 yards), the times for the $7\frac{1}{4}$-furlong races compare favourably with the times for the five (5) furlong races.

According to the "*Encyclopædia Britannica*," quoted ante, the fastest time in England for one mile was made at the Lingfield Course on 13th July, 1900, by "Caiman," in 1 min. $33\frac{1}{5}$ sec. = 56·65236 feet per second.

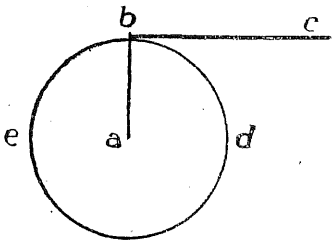
"Galtee More," a well-known horse, covered the Rowley Mile (1 mile 11 yards) at Newmarket in 1 min. $40\frac{3}{5}$ sec. = 52·8132 feet per second.

The previous fastest time over the Rowley Mile is said to have been 1 min. $42\frac{1}{5}$ sec. by "Marco" = 52 feet per second nearly.

Considering that the $7\frac{1}{4}$-furlong course at Kedron Park comprises three 3·5-chain curves; one 4-chain curve; one 4·5-chain curve; one 5-chain curve; five 6-chain curves; two 7-chain curves; one 8-chain curve; one 10-chain curve; and two 15-chain curves, whilst transversely the course is practically flat, it must be admitted that the races are run in quick time, reflecting credit on both horses and jockeys. All things considered, it is surprising that serious accidents are not more frequent.

CENTRIFUGAL FORCE AND BATTER.

"Centrifugal force" is the term applied to the force exerted by any body revolving in a circular path in its effort to obey the natural law which would induce it to depart from its circular course and proceed in a straight line tangential to the curve at the point of departure. The revolving body may be a planet, as Jupiter, Venus, or our earth; or it may be a wheel, a railway train, or a piece of metal tied to a string, and caused to revolve whilst the other end of the string is held in the hand. For example:—



Let "b" be a bullet fixed at end of a string a b and rapidly revolved round the circle b d e. After a number of revolutions the string a b breaks when in the position shown on the diagram.

The bullet "b" will no longer follow the circular course, but will fly off along the tangent b c. As already explained on page 13, centrifugal force varies directly as the weight, and the radius of the curve, but as the square of the velocity. If the body (b) is to be controlled, and forced, against its natural tendency, to follow a circular path, it must be controlled by a string as in the diagram, by the attraction of the sun in the case of a planet; by the axle in the case of a revolving wheel; by rails and super-elevation of the outer rail on curves in the case of railway trains; and in the case of horses galloping at speed round curves of limited radius, by means of sloping the racing track towards the centre, as is invariably done in hippodromes.

If the racing track is not sloped or battered sufficiently at any point on a curved course, then the centrifugal force (which later will be seen to be very considerable) must be overcome by the natural strength of the horse assisted by its rider pulling on one side or other of the reins as may be necessary. I will show later that the force required to keep a horse on a sharply-curving course, whether exerted by the horse or the man, or by both, is equivalent to additional weight imposed upon the horse whilst traversing those unbalanced portions of the track.

The following table, which is applicable to both the 5-furlong and the $7\frac{1}{4}$-furlong courses, is based upon the mean average time for both distances, namely, 51·2 feet per second.

A uniform weight of 800 lb. for horse and rider has been adopted for each distance.

The centrifugal force and corresponding batter have been separately computed for each curve of the entire course by equations (1) and (2) respectively, as stated on page 13.

TABLE OF CENTRIFUGAL FORCE AND BATTER.

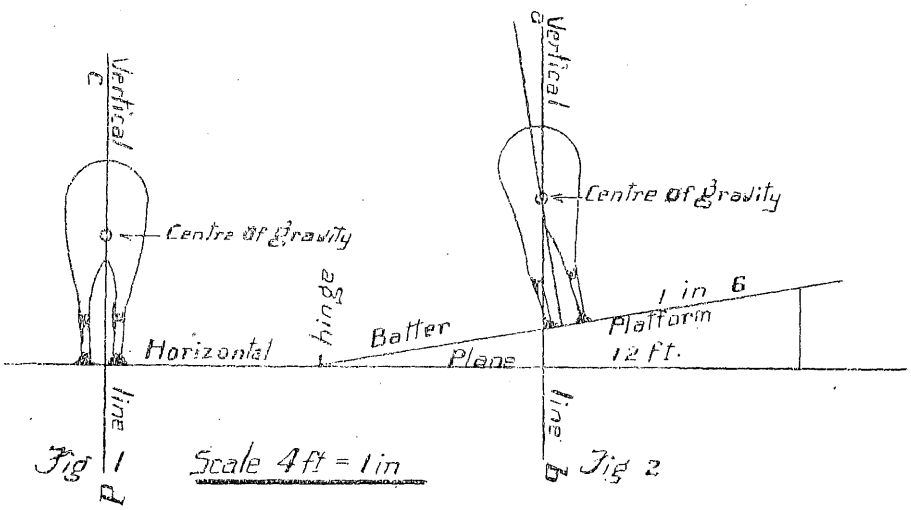
Radius of Curve in Chains.	Velocity in Feet per Second = 51·2.	Centrifugal Force in Pounds.	Amount of Batter required to Counteract Centrifugal Force $g = 32·2$.	Remarks.
3·5	Square of 51·2	282	1 in 2·8	Batter too steep
4·0	= 2621·44	246	1 in 3·3	do.
4·5	..	219	1 in 3·6	do.
5·0	..	197	1 in 4·0	do.
6·0	..	164	1 in 5·0	do.
7·0	..	141	1 in 5·6	Permissible
8·0	..	123	1 in 6·5	do.
10·0	..	98·7	1 in 8·0	do.
15·0	..	66	1 in 12·0	do.

From the above table it will be seen that speed equal to the mean average of no less than 203 races on the 5-furlong and $7\frac{1}{4}$-furlong courses is excessive for all curves less than 7 chains radius. I could easily compute the safe speed, and corresponding batters, for those curves, but it would be useless, as I believe it would be impossible to prevent jockeys exceeding those speeds on the respective curves. It is evident, also, that on such a short course as 5 furlongs the horses must go from the jump and race practically at their top speed right over the distance. It appears to me that the question to be decided at this stage of the investigation is, What is the maximum batter that should be adopted?

Horses, either standing, walking, or galloping, are supported by very small bases compared with their height, size, and weight. A galloping horse has never more than one foot on the ground. The small bases have the advantage of giving their feet great adhesion on the ground, especially when the soil is dry and not too hard. On the other hand, there is the disadvantage that horses may, under certain conditions, be somewhat easily thrown off their centre of gravity owing to a slip, trip, or collision with other horses—the latter being not uncommon on racing tracks, more especially on short distances like 5 furlongs, where a second or two gained, or lost, makes all the difference between success or failure.

Fortunately, as a rule, sound horses, not too old, are clever at keeping their feet even on the roughest and most unfavourable ground. I have seen stockmen ride fairly fast on steep and rough mountain sides in their efforts to bring in wild cattle or horses, but, of course, under such conditions accidents are not uncommon.

If a model were made of an average racehorse in some suitable material and placed loosely on a wooden platform hinged at one end, it can be shown that such a model would fall if the platform were tilted to a batter only slightly exceeding 1 in 6—see sketch below.



In the preceding sketch, Figure 1 shows the rear view of the model of a horse in transverse section standing on a horizontal plane, the vertical line c d passing through the centre of gravity and the centre of the base at ground level. A horse standing in that position is easily pushed to one side when being groomed, unless he opposes his strength to the push, and then it will be found to be not so easy.

Figure 2 shows the same model standing on an inclined plane of 1 in 6. It will be observed that the vertical line a b passes through the centre of gravity of the model, but falls just on the outside edge of the near hind foot. The model, therefore, is just on the point of falling—the slightest push from the off side, or the least additional tilt to the platform, would overset the model on its near side.

Of course, a live horse would not fall on a much steeper slope than 1 in 6, because he would lean towards the higher side, but if the same horse were fully extended in the gallop at 50 or 55 feet per second, it would not take a very great thrust from the offside to overset him, as might easily be caused by a faster horse trying to pass him for position.

No doubt, on the small curve of a hippodrome or circus, where the performing horses never exceed a smart canter, much steeper batters than 1 in 6 are admissible, but under racing conditions, where the jockeys' very living depends upon their taking great risks, and seizing every momentary opening to improve the position of their horses, I think it would be decidedly undesirable to exceed 1 in 5 as an absolute maximum slope, but, for the reasons I have stated, 1 in 6 would be preferable.

The centrifugal force on a batter of 1 in 5 for a weight of 800 lb. should not exceed 160 lb., which implies a permissible maximum speed of about 50 feet per second. On reference to the Table on page 16, it will be seen that such data practically correspond with a 6-chain radius curve, but would exclude all curves of less radius.

Just here I might quote from Mr. Weingarth's article on the "Formation of Racecourses" —*Vide* "The Surveyor" of 31st March, 1915, page 41 :—On the subject of curves Mr. Weingarth said : "From my experience, I am satisfied that there should not be a curve less than 5 chains radius, and that the curve leading into the finishing straight should not be less than 6 chains radius. I have heard of a course having been laid out with curves of 3½ chains radius, so as to get the required length of 6 furlongs, and the track was registered by the Government. In my opinion the curve (3½ chains radius) is absolutely dangerous. Of course, a very steep batter across the track will help to minimise the danger, but the risk is very great." Mr. Weingarth does not state what the batter should be on curves of 3·5 chains radius, but on reference to my Table on page 16 it will be seen that for the stated velocity of 51·2 feet per second, weight of horse and rider 800 lb., the batter corresponding with the tabulated centrifugal force of 282 lb., is 1 in 2·8, which, needless to say, is much too steep.

With a batter of 1 in 5 on curves of 3·5 chains, weight of horse and rider 800 lb., the speed should not exceed 38·6 feet per second, equal to 75·4 per cent. of the mean average speed of 203 actual races on the 5-furlong and 7¼-furlong courses, namely, 51·2 feet per second, as adopted by me in the preparation of Table on page 16.

It is probable that if horses could be restricted to speeds as conditioned by curvature and batter, it would be found that they could not complete either the 5-furlong or the 7¼ furlong courses on the Kedron Park Racecourse in the times stated in the official time records. I could prepare Tables dealing with this aspect of the subject, but they would involve considerable labour, and in my opinion are not necessary, as I agree with Mr. Weingarth that curves of less radius than 5 chains should not be permitted on any racecourse ; in fact, I think that the limit should be fixed at 7 chains, and a 10-chain radius curve entering the final straight Such limiting curves would permit of the fastest speed with reasonably flat batters.

The Kedron Park Racecourse could be remodeled to comply with Mr. Weingarth's limits of 5-chain radius curves, with a 6-chain radius curve entering the final straight, as shown in red on the blue-print copy of Mr. Greensill's plan of the course. The course, as so remodeled, would be 6 chains shorter than at present. It would also reduce the length of the final straight by about 2½ chains, and necessitate a slight alteration of the south-west end of the Trotting Track. With a batter of 1 in 5 or 1 in 6, on the 5-chain and 6-chain radius curves the remodeled course would be speedy and much safer than at present.

As the total length of the course as suggested would be 53·5 chains, there would be no difficulty about the 5-furlong races.

As regards the longer races (7¼ furlongs) if the distance were increased to one (1) mile, the starting point could be at, or close to, the present 3-furlong post, at the back of the course, on straight. This would mean one complete circuit of the remodeled course, plus 26·5 chains, so that the spectators would be twice passed by the horses.

The present track, as revealed by Mr. Greensill's very admirable plan, has several very ugly and dangerous corners, whilst the track being flat transversely, the centrifugal force, which is very considerable (*vide* Table on page 16), is quite unbalanced. This state of things, in effect, results in an unseen, but not the less very real, extra weight being imposed on the horses at sharp curves. Each horse is carrying his own weight plus that of the jockey, saddle, &c., which I have assumed on an average to amount to 800 lb. all told. Also, when galloping round the smaller curves of from 3·5 to 4·5 chains radius, at a reduced speed of say 45 feet per second, the mean centrifugal force on those curves amounts to 192·6 lb., which represents a horizontal thrust pushing each horse away from the circular course. By the parallelogram of forces (*see* diagrams below) it will be seen that the resultant force equals the square root of 800 squared plus 192·6 squared = 822·8 lb., that is to say the average horse of 800 lb., including imposed weight, when galloping at 45 feet per second round the 3·5 chains, 4 chains, and 4·5 chain curves, unbalanced by batter as at present, is actually sustaining not merely 130 lb., the average weight of jockey, &c., but 152·8 lb. = 10 stone 12·8 lb.

If any horse ever succeeds in galloping round a 3·5-chain curve at the average speed adopted in Table on page 16, namely 51·2 feet per second, the tabulated centrifugal force of 282 lb., unbalanced by batter, represents an increased weight on the horse of 48 lb. = 3 stone 6 lb. (Total weight with jockey, &c. = 12 stone 10 lb.)

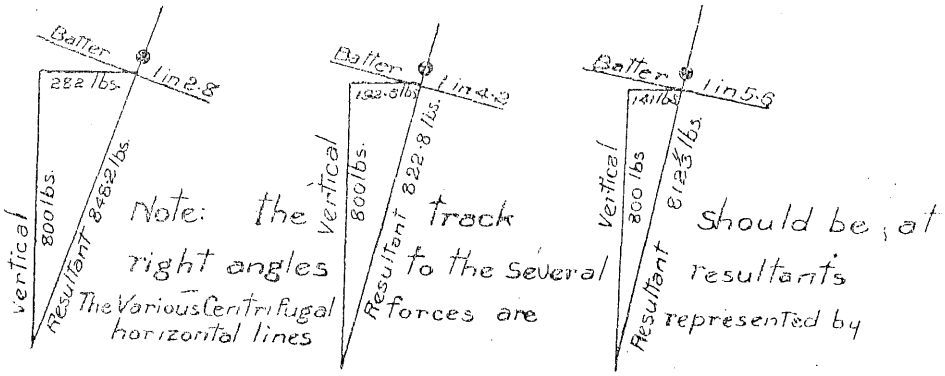


Fig. 1. Fig. 2. Fig. 3.

Fig. 1 represents a horse galloping round a 3·5-chain curve at 51·2 feet per second on a battered track of 1 in 2·8, which, of course, is much too steep.

Fig. 2 represents a horse galloping round curves of 3·5 chains, 4 chains, and 4·5 chains, at 45 feet per second, on a mean battered track of 1 in 4·2, which I regard as too steep.

Fig. 3 represents a horse galloping round a curve of 7-chains radius at the tabulated speed of 51·2 feet per second on a battered track of 1 in 5·6 as per Table on page 16 ; evidently a 7-chain radius curve is a desirable minimum.

For the benefit of those who may be sceptical of the effects of centrifugal force—(*a*) the practical, because hundreds of races have been run at Kedron Park without accident or visible difficulty, and (*b*) the ignorant who never heard of centrifugal force—I will quote two common tricks :—

1. The bushman's trick of swinging a billy full of water rapidly round his head at arm's length without spilling the water ; and

2. The trick cyclist's stunt of riding round the inside of a circle in a vertical plane similar to a railway tunnel, in the course of which, at the crown of the arch, he rides head downwards.

This trick looks dangerous, but if the centrifugal force developed exceeds the weight of man and machine, he will not fall ; for example :—Let the vertical circle have a diameter of 30 feet ; weight of man and machine, 150 lb. ; velocity, 25 feet per second (equal to 17 miles an hour). Under the conditions named the centrifugal force would exceed the weight of man and machine by 44 lb., and he will not fall, although riding head downwards.

THE SAFETY RULE.

For those upon whom the duty of laying out racing tracks for horses (not ponies) may devolve, the safe rule is as follows :—If the centrifugal force developed on any curve demands a batter steeper than 1 in 5 as a maximum, that curve is not only dangerous but incurably so, and should be discarded. This rule, if strictly adhered to, would, at Kedron Park Racecourse, exclude any curve of less radius than 6 chains—*Vide* Table on page 16.

Yours faithfully,

GEO. PHILLIPS,

Authorised Surveyor and Civil Engineer.

APPENDIX III.

FORMATION OF RACECOURSES.

By JOHN WEINGARTH, L.S.

Paper read by The President (Mr. John Weingarth), at a Meeting of the Institution of Surveyors, N.S.W., on Tuesday, 16th March, 1915.

The surveyor, in laying out a Racecourse, is necessarily bound by the shape and area of the land available. In my opinion, the ideal shapes for a track are : the parallelogram with the corners rounded off, and the triangle with the corners rounded off, having a width of 100 feet, and with curves of not less than 8 chains radius. (See Diagrams 1 and 2.)

Under the law in New South Wales no course with a circumference of less than 6 furlongs will be licensed, the measurements to be made at a distance of 3 feet from the inner rail. There are two classes of racing recognised by the authorities—horse racing and pony racing. For ponies, a track 6 furlongs in length is adequate, but for horses it should be not less than 1 mile. On courses in New South Wales, horses run with their off side along the inner rail—that is, the jockey's right leg is next to that rail ; in Victoria, the horses run the reverse way.

When laying out a Racecourse it is necessary at first to make a survey of the land available, then to design the track after the length has been decided upon, leaving ample room for Grandstand and Leger enclosures in a suitable position for access from public roads. In the Government Regulations it is stated that the curves must not be dangerous, but the minimum radius is not given ; this is a question that should have been fixed by Regulation and not left to the discretion of a Police Officer. From my experience, I am satisfied that there should not be a curve of less than 5 chains radius, and that the curve leading into the finishing straight should not be less than 6 chains radius. I have heard of a course having been laid out with curves of 3½ chains radius, so as to get the required length of 6 furlongs, and the track was registered by the Government. In my opinion the curve is absolutely dangerous. Of course, a very steep batter across the track will help to minimise the danger, but the risk is very great. The surveyor should design the track with a finishing straight of at least 10 chains in a 6-furlong track and 15 chains in a mile track, a curve of not less than 6 chains radius leading into that straight, then other straights and curves. The straight to the winning-post should be in such a position that the spectators will not have the sun shining in their eyes when looking at the horses entering that straight.

Length of horse races are 4 furlongs, 4½, 5, and 5½ for two-year-olds only ; and 6, 7, 8, 10, 11, 12 furlongs, 1¾ miles, 2 and 3 miles, for other horses. Ponies have distances from 4 furlongs upwards. There should not be a start on a curve or on the end of a straight leading into a curve ; therefore, the design should provide for as many as possible of those starts to be on straights of at least 4 chains before entering a curve, so that the field will have time to string out before reaching the curve.

For those starts not possible to arrange as suggested a starting lane should be laid off the main track as shown on Diagrams. On most of the courses around Sydney this scheme has been adopted, still there are cases where starts are on curves or on a straight at the commencement of a curve. I will refer to this matter later on.

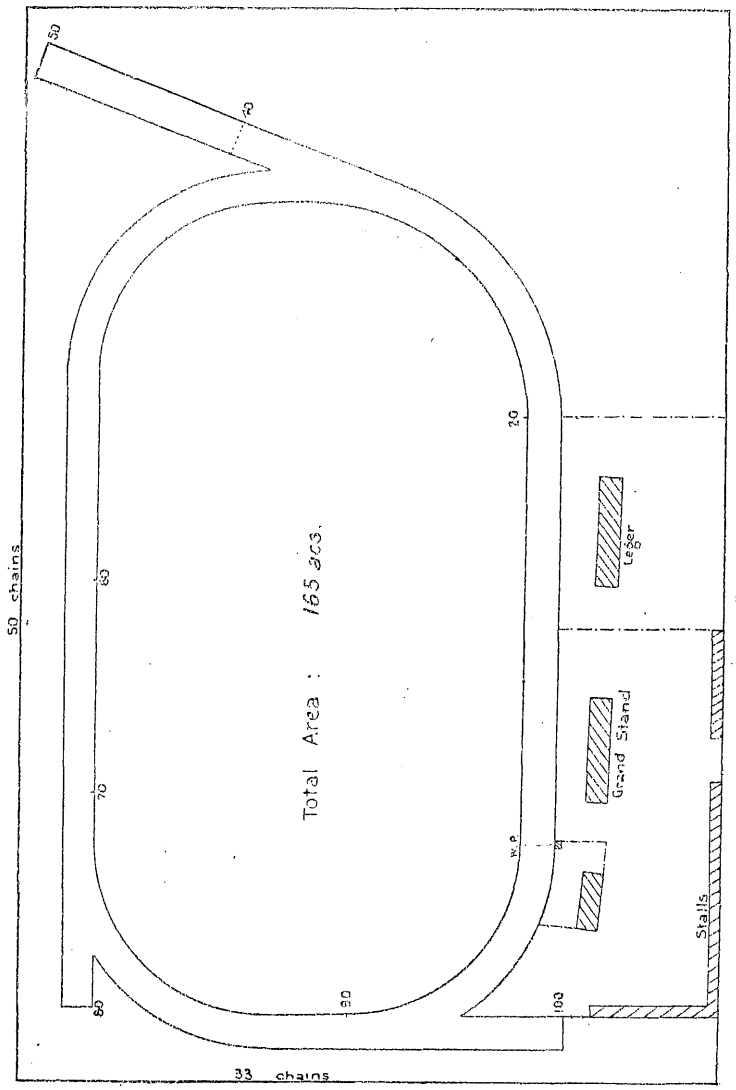


DIAGRAM 1.

The surveyor will then peg out the inside line of the track. If it is on fairly level ground, with sufficient area, there is no doubt the course can be formed ; on hilly ground it may be found that the design will not suit, but the surveyor will then have got a good idea as to what alterations are required. The question of drainage must be kept in mind, as it is necessary that heavy storm water should run away quickly, otherwise the track might get very sodden and unfit to race upon for weeks.

When a design suitable to the ground has been found, and the lines pegged out, levels should be taken and the grading decided upon. There is no necessity to have one grade right round the track. The finishing straight should be nearly level or slightly downhill towards the winning-post ; on the remainder, the grade should not be steeper than 1 in 40 if going downhill and 1 in 60 going up hill. Reducing those grades to fairly level would certainly be preferable, but sometimes this means a very great increase of cost for construction. At the same time it must be remembered that horses galloping down a steep grade tear up the surface, causing extra expenses for top dressing. Along straights the track should be formed with a fall from the outside to the inside of about 1 in 66, for purposes of drainage, and to ease the batter round the curves. It is necessary to have a dry track, so that if rain falls during a meeting the water will run off quickly. Around the curves, not only for drainage purposes but for safety in running, there

should be a good batter across the track, and the minimum should be 1 in 30 decreasing to 1 in 66 about 5 chains along the straight. Inside the inner rail a drain should be dug 2 feet wide at top and 1 foot deep, so as to carry off the storm-water.

After the formation has been made it should be covered with 6 inches of top soil mixed with grass roots. The best soil is a sandy loam, which dries up quickly after rain. The roots of grass solidify it and it becomes firm and fast. All grasses that grow in clumps, like Parramatta grass, should be dug out. An outer and inner fence should be erected, and the surveyor should put in pegs around the turns for every post of the inner rail, so that there will be a true curve; for the outer rail, a peg every three or four posts will be sufficient.

I quite realise that it would be very costly for small country Racing Clubs being compelled to fence round a course, but isolated posts along the inside of the track are very dangerous, many jockeys having been killed through colliding with them, and there is also the opportunity of one jockey forcing another inside the post, so as to disqualify the horse in the race. As the law states that the course must be not less than 6 furlongs in length before it will be registered, and that the distance must be measured 3 feet from the inner rail, that pre-supposes there is a rail right round the track.

One often sees a report of a country meeting where a horse runs off the track and the jockey is killed through being knocked against a tree. Should a horse run among the spectators a very serious accident might happen, therefore it is very advisable to have both sides of the track fenced.

Compulsory grassing of tracks would also be too expensive for small country courses, but, if there is no grass, I consider racing to be very dangerous—a cloud of dust is raised, the jockeys cannot see, although horses appear to be able to do so to a certain extent. Before races are held an inspection should be made of the track to see if there are any soft patches. A horse going suddenly into soft ground is very likely to fall.

The railing round the inner side of the track should be about 3 feet 6 inches above the ground. Posts should be placed about 10 feet apart, a block 3 inches thick nailed to the top of the post, and then the rail nailed to the block; a bolt should then be run through rail, block, and post, with the head towards the track and well sunk (see Diagram 3). Often during races jockeys' legs are crushed against the rail; it is, therefore, necessary to have a smooth surface. The grain of the wood should be with the way of running, so that splinters will not spike the jockeys' legs. The rail should be 6 inches wide and 2 inches thick and of wood that will curve nicely.

The end of the Grandstand should not be nearer than 20 feet from the line of the winning-post, and no spectators should be allowed in that line, otherwise there would be continual adverse opinions to the judge's verdict, which should be avoided as much as possible. The front of the Stand should not be parallel to the outer rail; the end nearest the winning-post should be, say, 80 feet from that rail, and the other end, say, 90 feet from it, that is allowing for the Stand to be

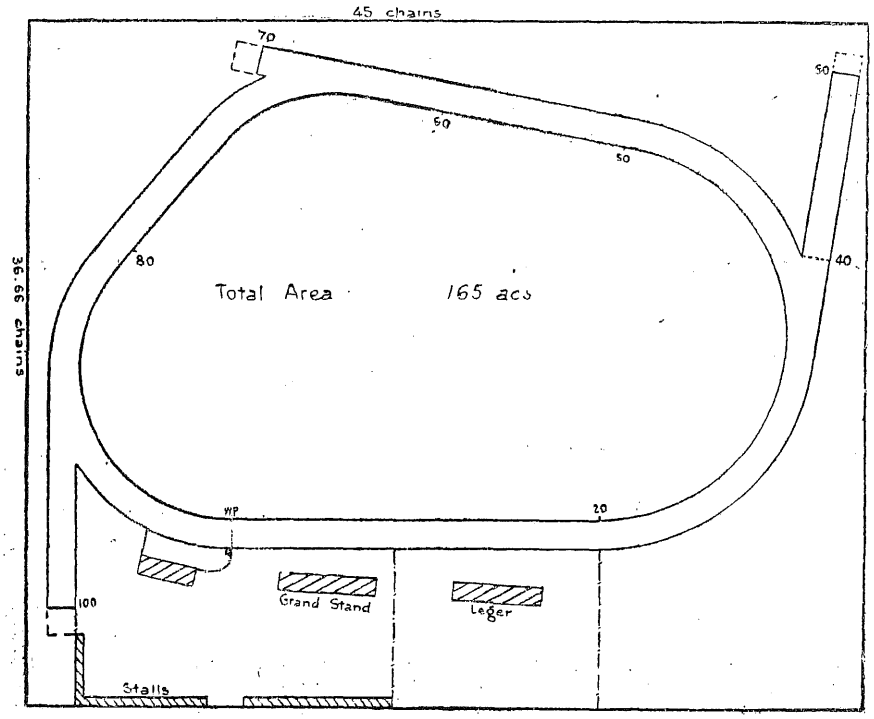


DIAGRAM 2.

60 feet long; this would give the spectators a better chance of seeing the races than if the building were parallel to the track. The lowest step should be 4 feet above the level of the track, and the ground banked up from the outer rail to 20 feet from the stand. The same with the Leger Stand. The Grandstand enclosure should be large enough to permit of the building of horse stalls, and plenty of room for the public and the betting ring.

The distance of the judge's box from the track is, probably, a matter for the Judge to decide. Personally, I should advise that it be 10 feet. On our courses the winning-post is marked by a thick black line on a broad white board, and there is an iron upright rod on the outside fence, the judge's eye being in the line of the two marks. In America, I understand that two wires are stretched from the winning-post to the outside of the track, one several feet from the ground, the other several feet above that; the judge's eye is still higher than the top wire and he can get a good guide even if one horse finishes near the inner rail and another near the outer rail.

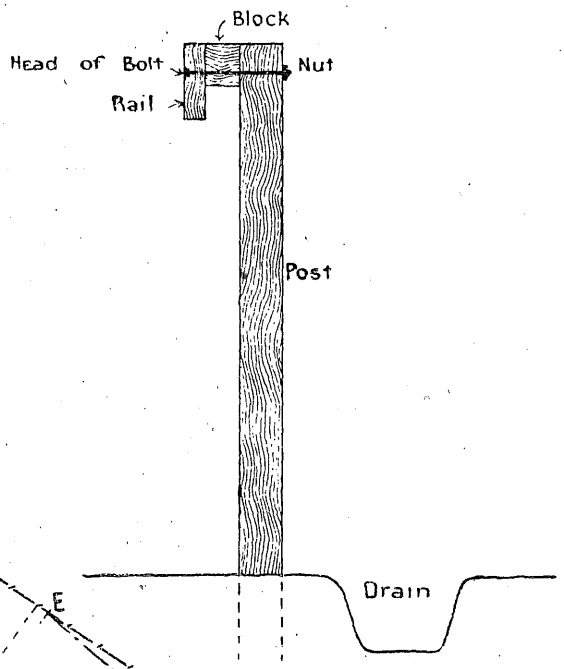


DIAGRAM 3.

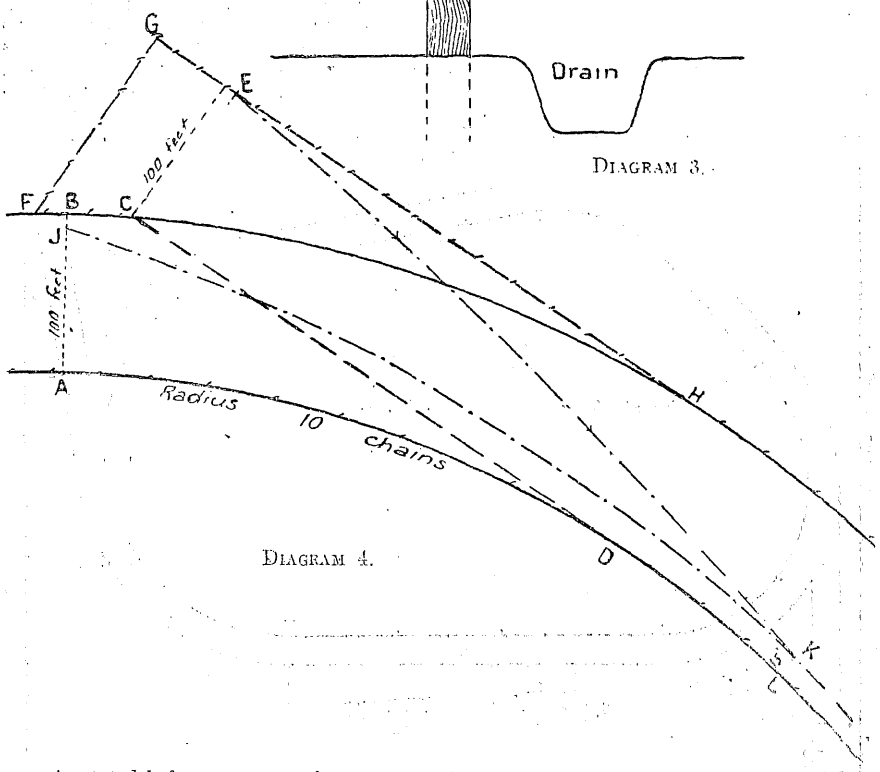


DIAGRAM 4.

As stated before, on some of our courses there are starts on curves and on a straight at the commencement of a curve. Generally the starting-gate is placed at right angles to the inner rail in the latter case, and at a line at right angles to the tangent of the curve in the first case, as shown by letters A B on Diagram 4. This is unfair to the outside horse. It is generally accepted

that on a straight, where there is a straight run for several chains before reaching a curve, the starting-gate should be at right angles to the inner rail, and if proprietors will not make a starting-lane off the course proper, so as to provide a fair length of straight, then the course should be widened by including a triangle, such as F. G H on Diagram. A straight line of hurdles could be placed from C to D, then the starting-gate should be placed at C E at right angles to C D ; the outside horse of a big field starting at E would approximately follow the curve E K a distance of 500 feet, but a horse starting on the outside of a curve, say at J, would have to travel about 530 feet to reach K ; therefore, by having a start on a curve or at the end of a straight leading into a curve, the horse on the outside rail is unfairly treated to the extent of about 30 feet. Of course, that could be reduced by throwing the outside end of the starting-gate forward. The distance the inside horse would have to go from C to reach a point on the rails opposite K would be about 490 feet.

It is found that, even if a large number of horses start in a race, the field generally tails out quickly and that a width of only about 12 feet out from the inner rails is used. This, of course, gets cut up by the hoofs, and continuous top-dressing and filling up of the holes makes that 12 feet level. The course then is in a dangerous state. The batter has the effect of horses keeping parallel with the inner rail ; where there is no batter, the horses are inclined to run off, notwithstanding the pressure on the bit, and some horses are more prone to it than others. Should the inside horse of a bunch run off ever so little, he will collide with another horse. Also, when there is no batter, the near legs have not sufficient support, the horse is going round a turn, the jockey leaning towards the rail and is pulling the off rein, and the whole weight is on the off legs, so that if one of the legs is touched by another's leg, it is apt to bring him down.

So many accidents occur going round curves, that every point should be carefully looked into, and the Australian Jockey Club might some day employ a moving picture camera man to take photos of three horses running abreast around a curve where there is no batter, and also where there is a batter, so as to compare and decide as to the amount of batter required for safety. Many of our racecourses have training tracks, known as tan tracks. The formation is made of cinders, well rolled. The residue of tar in the cinders seems to consolidate it, and the surface becomes very hard. On top to a depth of 6 inches is laid tan which has been finished with at the tan pits. In time the fibre is broken up and becomes nearly dust ; then when rain falls it is practically mud and useless. Probably stringy-bark smashed up into proper size would be more suitable.

APPENDIX IV.

"GAME CHICKEN" BENDING.

Price 1*s.* 3*d.*]

By Authority: ANTHONY JAMES CUMMING, Government Printer, Brisbane.