cently from the depths of the crowd in the Poultry. "Why, he has got no power astern; he climbs along!" And that is exactly the state of the case with hundreds of the London vanners. But then such horses are possible because they are cheap, and we must not expect too much of them. Their life is a hard one. As a rule, they are worked long and wearily; but, unlike "that useful horse, the hackney," they have a Sunday's rest.

The hackney is too useful a horse for his own good. Six days a week he works to earn money, and on the seventh he works to spend it. And so the hackney is soon knocked up, and changes hands oftener than any horse in London. Yet one more class of first-handers, and that is the ponies, which keep to their first owners longer, and, in the ownership of sweeps, attain frequently quite a remarkable healthy old age. And with the first-hand ponies and hackneys our herd reaches the 150,000, and we confirm the usual estimate that half the London horses are at least second hand.

Three hundred thousand horses! Not a tenth of what there are in this island; but what a herd it seems! And what are they worth? Taking them at £25 apiece they would run to £7,500,000, and that, as we have seen, would be putting them at a low price. To keep them at less than half a sovereign a week we should require seven and a half millions a year; and if we add to this current cost the interest on the capital sunk in them, and their harness, the wages paid in looking after them, and the rent of their stables, we shall get into figures that seem almost too large to be true.

The London horses rarely die natural deaths. Many of them are sent back into the country in a vain hope that they will "come round;" many of them are poleaxed for very shame at their miserable appearance; some of them slip and injure themselves beyond recovery in the streets.

A dreadful object this of a suffering horse sprawling in one of our main roads with the usual crowd around it. "Why cannot he be killed at once? Why must he

meat. Maneless he stands; a shade is put over his eyes; a swing of the ax; and, with just one tremor, he falls heavy and dead on the flags of a spacious kitchen, which has a line of coppers and boilers steaming against two of its walls.

In a few minutes his feet are hooked up to cross beams above, and two men pounce upon him to flay him; for the sooner he is ready, the quicker he cooks. Slash, slash, go the sharp knives, and the hide is peeled off about as easily as a table cloth; and so clean and uninjured is the body that it looks like the muscle model we see in the books, and in the plaster casts at the cornchandler's. Then, with full knowledge gained by almost lifelong practice, for the trade is hereditary, the meat is slit off with razor-like knives, and the bones are left white and clean and yet unscrapped, even the neck vertebræ being cleared in a few strokes—one of the quickest things in carving imaginable.

If there is any malformation, the sweep of the knife is stayed for a moment; that is all. The same sort of thing has always been seen before, and there is no hesitation about the way to deal with it. No matter of what breed or age or condition the horse may be, his "boning" is not delayed by peculiarities. And horses of all sorts, some of them sound and in the prime of life, here meet their doom—the favorite horse killed at his master's death, to save him from falling into cruel hands; the runaway horse that has injured a daughter; the brute that has begun to kick and bite; the mildest mannered mare that has perhaps merely taken a wrong turn and made her mistress angry—all come here to die with the hundreds of the injured and the old. Taking them all round, the old and young and sound and ailing, they average out in the men's opinion at rather over eleven years when they here meet their doom.

Soon the bare skeleton remains to be broken up, and in baskets go aloft to be shot into a huge digester, where it is made to yield about a quarter hundred-weight of oil. Following the oil, we see it cleared of

Harrison Barber, Limited, the successors of the once great Jack Atcherley, dead some thirty years since, kill 26,000 London horses a year. All night and all day the work goes on, this slaying and flaying, and boning and boiling down, and this cooking for feline food. Go to any of their depots between five and six o'clock in the morning, and you will find a long string of the pony traps and hand carts, barrows and perambulators, used in the wholesale and retail cat's meat trade. The horse on an average yields 2 cwt. 3 qrs. of meat; 26,000 horses a year means 500 a week, which in its turn means 70 tons of meat per week to feed the dogs and cats of London.

This is not all the "meat" that is sold, nor all the London horses that are killed, for the horseflesh trade is large enough to employ thirty wholesale salesmen; taking even this ten tons a day, we shall find it means 134,400 meals, inasmuch as a pound of meat cuts up into half a dozen ha'porths—the skewers being given in, though it takes half a ton of them to fix up a day's consumption. Here is another item for the forest conservation people! 182½ tons of deal used a year in skewering up the horses made into meat by Harrison Barber!

Sometimes there is a glut of the aged and the maimed, and the supply of meat exceeds the demand. To cope with this difficulty a complete refrigerating plant is at work at Wandsworth, cooling the larders, in which two hundred and fifty horses can be stored; which larders are not only a revelation, but a welcome surprise.

A door is opened and shut, and we stand in the darkness between two doors in an air lock; the inner door is opened, and a shiver of cold runs through us as a match is struck and a candle lighted; and there in front is what looks like a deep cave in an arctic drift. Around us are piles of meat, all hard as stone and glittering with ice crystals; overhead, and at the back of all, the beams and walls are thick with pure clingsnow; and from above a few flakes fall as the door closes on the silvery cloak that wraps the last to leave the horse world of London.—*Leisure Hour.*

AN OBSTACLE TO SCIENTIFIC PROGRESS.

By Dr. G. GORE, F.R.S.

THE recent recovery of Mr. Waterston's paper from the Archives of the Royal Society by Lord Rayleigh, and its publication after having lain there about fifty years (see *Chem. News.*, vol. lv., p. 219), illustrates the less encouragement given in this country to scientific researches containing really original conclusions or phenomena than to any other kinds of such researches.

As scientific researches which are reliable and original are as necessary and valuable as those which consist of accurate measurements without originality, it seems desirable that some arrangement should, if practicable, be made, by means of which such papers as that of Mr. Waterston's (and probably others) would be saved from oblivion, and be, if possible, as competently examined and as fully recognized and published as less original ones. However important a high degree of accuracy of measurement of known phenomena is, the discovery of entirely new phenomena and new truths is essentially more important, for if no new phenomena or truths were discovered, there would be none to be measured. Out of Faraday's simple qualitative discovery of magneoptic action arose Clerk Maxwell's mathematical theory of light.

A great obstacle, however, to the accomplishment of this very desirable object arises from the following circumstances: (1) All new truths require to be expressed in new language; (2) in consequence of the fixity of strongly impressed previous ideas in the brain, new discoveries and conclusions are only fully appreciated by a new generation of men; and (3) as the examiners of scientific researches are frequently teachers of long experience, their ideas are apt to become so fixed by long-continued teaching that, notwithstanding their anxiety to do justice to the authors, they are unable to fully understand the new phraseology and phenomena, and therefore discourage the publication of really original researches. The so-called "conspiracy of silence" of scientific men respecting the reality of new scientific discoveries is simply a result of this fixedness of mental impression; the examiners being men of high ability and integrity hesitate to express opinions of matters which they do not fully and clearly comprehend, and other men of science follow their example and remain silent.

It is largely in consequence of this hindrance, and of the almost universal desire of mankind for some immediate advantage, that any and every kind of scientific occupation is more encouraged than fundamental original experiment; accounts of inventions and technical investigations are accepted and published as if they were of greater value than the discoveries upon which they are based, and accurate measurements of known phenomena are treated as if they were of more importance than the discovery of new fundamental truths; and the readiness of acceptance and publication of a new truth is often inversely proportionate to its degree of essential importance.

To make laborious and expensive researches, and have them (and especially the valuable experimental evidence contained in them) practically suppressed and consigned to oblivion simply because they are original and cannot be readily understood, is most discouraging and unjust to investigators, a great obstacle to scientific and national progress, and deserves the serious consideration of those publishing bodies who undertake the acceptance or rejection of scientific papers.

Probably the most effectual method of overcoming the difficulty would be for a committee of paid examiners to actually repeat a sufficient number of experiments, etc., to enable them to arrive at a demonstrable conclusion in each case. This, however, would be an expensive plan, but it would be only a small expense in comparison with that of making the researches themselves, and the importance of the object would justify the cost. The skill and labor required would be too great for unpaid examiners.

The progress of science can never be very satisfactory in this country until this obstacle is removed, nor until scientific men generally treat different problems and truths of science more in accordance with their essential degrees of importance and less according to their

THE KNACKER'S REFRIGERATOR.

linger in agony? Surely—" Quite so, gentle reader and indignant letter writer to the daily newspapers, but do not be in a hurry! The driver has no right to order the horse to be killed; it is not his property, but his master's; and before he can give the order the master has to be found, and the master does not, in many cases, care to lose his horse irrevocably, and appeals to his vet.; and so, while the driver is finding his master, and the master is finding his vet., the horse lies suffering in the street. When the needful permission is obtained, a telephone message to Harrison Barber brings the cart on the scene, and within half an hour of that message the horse is not only dead, but being cut up in one of the Harrison Barber depots. There are seven of these depots in strategical positions round and in London, where the carts are kept cleaned and in readiness, tools and all, like fire engines, ready to be turned out and on the way in less than five minutes from the receipt of the call.

A curious trade is that of the horse slaughterer, who must not only have a license, but carry on his operations in accordance with the 26th of George the Third and other acts of Parliament. No horse that enters his yard must come out again alive, or as a horse. The moment it enters those gates it must be disfigured by having its mane cut off so close to the skin as to spoil its value, and though it may be put in a "pound" on the premises, which might better be called a condemned cell or a moribundary, it must not remain there for more than three days.

In Garratt Lane, Wandsworth, is the largest horse slaughtering yard in London. It has existed for about a hundred years. There it stands, practically odorless, by the banks of the winding Wandle, with a wide meadow in front of it and a fireworks factory next door, the magazine of which is within measurable distance of its boiler house. One fine morning—it was really a beautiful morning—we found our way down the lane, along the field, armed with Mr. Ross's permit, to be initiated by Mr. Milestone into the mysteries of a horse's departure from the London world.

The last scene does not take long. In two seconds a horse is killed; in a little over half an hour his hide is in a heap of dozens, his feet are in another heap, his bones are boiling for oil, his flesh is cooking for cat's

its stearin, pressed out between huge sheets of paper, and remaining in white cakes like gauffres ready for the candle makers; and we see the oil flowing limpid and clear into the tank above, from which it is barreled off to be used eventually for lubricating and leather-dressing purposes.

Returning to the bones, we find them out on the flags, clean and free from grease, ready to be thrown into a mill, from which they emerge like granite from a stonebreaker, down along a sloping cylindrical screen, which sorts the fragments into sizes varying up to half an inch. And stretching away from us are sacks, full to the brim, with bones all in rows, like flour sacks at a miller's, all ready to go off to the manure merchant's. And still further following the bones, we find some of them ground to powder and mixed with sulphuric acid, to leave the premises as another form of fertilizer.

Having seen the bones off the premises, we follow the feet, of which we find a huge pile, not a trace of which will be left before the day is out. The skin and hoofs will go to the glue makers and blue makers; the bones will go to the button makers; the old shoes will go to the farrier's and be used over and over again, welded in the fire and hammered on the streets, so that all that is lost of a horseshoe is what rusts or is rubbed off in powder.

With a glance at the tails and manes, which will soon be lost in sofas, chairs, or fishing lines, we reach the heap of hides, which will probably find its way to Germany to be made into the leather guards on cavalry trousers, or may be stay in this country for carriage roofs and whip lashes. This distribution of the dead horse may seem to be an odoriferous business, but the odors are reduced to a minimum by an elaborate ventilating system which draws off all the fumes and emanations into a line of pipes, and passes them over a wide furnace to be burnt, so that none of them reach the outer air.

But now for the "meat" which, cut into such joints as the trade requires, has been boiling in the coppers and is now done to a turn, with just the central tint of redness and rawness that suits the harmless necessary cat, while the "tripe" is doing white in another copper to suit the palate of the less fastidious dog.

extrinsic or *immediate* practical value. Nor will science itself be treated with the highest respect while scientific men in general pursue money and trading in knowledge so much more earnestly than knowledge itself. We are all apt to be blinded by the prospect of immediate personal gain, and fail to perceive the deep-seated sources of greater good which lie latent in increased fundamental knowledge. The idea that immediate personal gain is always the greatest good, and that money is essentially more valuable and a greater source of happiness than knowledge, are only worthy of the darker ages; the greater good, however, takes a longer time to grow. Great good *must* come from new truth, even when we cannot see the way; new facts are the origin of human progress, and great truths are the parents of great uses; there can be no inventions without the facts upon which to base them, and the progress of mankind is greater in proportion as the facts discovered are more comprehensive; for instance, out of the simple qualitative fundamental fact of magneto-electric induction has arisen the dynamo-electric machine and all its world-wide uses. Other similar examples might easily be adduced.—*Chem. News.*

THE COPPER MINES OF SPAIN.

THE British Vice Consul at Huelva, in his trade report for the past year, says that the great strides in prosperity made by the province of Huelva during the last twenty-five years are due to the scientific development of its enormous mineral wealth. It is not, however, the first time that that mining district has been the scene of great activity, for the large masses of ore in its mountains furnished quantities of highly-prized metal to the old nations of the Mediterranean. According to history and tradition, the Phenicians were the first known people to work the Huelva mines, remains of their workings, ovens, coins, and other articles having been found in most of the mines. After the Phenicians came the Romans, and during their dominion in Spain mining operations were greatly extended, as is proved by the great amount of scoriae to be found in every mine. This is calculated to be in all 20,000,000 to 25,000,000 tons, showing that immense quantities of ore must have been extracted during the centuries of Phenician and Roman work, until it ceased with the invasion of the Vandals. It is not apparent that either the Goths or Moors worked the Huelva mines, so that they have practically been idle for fourteen centuries, for the little that was done during the last and first half of this century can hardly be taken into account. The first great impulse was given by the foundation, between 1868 and 1875, of large foreign companies. The mines began to be thoroughly opened out, railways were constructed to the port of Huelva, and magnificent shipping piers were built in the river. Other companies then followed, and a period of great activity set in, completely altering the aspect of the province and of the port. The copper pyrites, or cupreous sulphur ore, composed of about 48 per cent. sulphur, 44 per cent. iron and 3 per cent. copper, is the principal ore mined in the district, and contributes very considerably to the copper production of the world. By far the greater part is sent to Great Britain, although large quantities are sent to Holland and Germany; France and the United States are also consumers, and a small quantity goes to Denmark. British vessels convey nearly all the copper pyrites, but a good many cargoes have been shipped to Germany in German steamers. The pyrites sent to the United States is of the poorer class, containing about 1.25 per cent. of copper only on the average, and is shipped principally to Philadelphia and New York. The ore is also partly treated at Huelva by smelting, which produces the regulus, containing about 30 to 40 per cent. of copper, and by precipitation on to pigiron in large tanks, giving cascaded or precipitate with 60 to 95 per cent. of copper, according to treatment. The iron pyrites is what is called pure—that is to say, it contains 44 per cent. of iron and 52 per cent. of sulphur, but no copper, and it is extracted from one mine only. Besides the considerable quantities shipped to Great Britain, there is a large consumption in France, Germany, and the United States; it is, as a rule, friable and not hard and compact like copper pyrites.

DICKSONIAS.

THE fine examples of these plants which are to be seen at the Earl's Court exhibition recall to mind the splendid specimens that were shown at the last international show. Tree ferns now, for some reason, have lost their fascination. I am told that the fine plants that used to exist near Dublin, in Mr. Bewley's garden, have disappeared too. This is a great pity. A large trade was at one time done with the antipodes in tree ferns. The safest and surest way of getting them home alive was in the ships that came home laden with wool, and I have bought several hundreds at various times so brought home. From inquiries that have been made of me from time to time I am inclined to think these plants will again be in demand. The best size in which to import these stems is from 4 ft. to 6 ft. in height. These should be straight and sound, so that when potted they have no holes in their sides needing patching up, which I have heard many people advocate being done with Sphagnum moss. This should never be resorted to, for it makes a faulty and rotten stem at the best. These plants when brought home in a dry state should have their stems well soaked without letting a drop get into the crown, and they should be let stand in a shed or shady part of the conservatory or greenhouse, keeping the stems sprinkled; here they will soon begin to push roots. Upon the first signs of movement the plants should be potted, using fair-sized pots, which should be well drained. The best soil to pot them in is equal parts of good fibrous loam and peat, making the whole tolerably sandy. The stems should be potted very firmly, and they may be stood in a shady place in a house until their crowns have developed. The stems must be kept well sprinkled, but none should be given the crowns until they begin to push up fronds. I do not like the system of placing these plants in the stove to force their growth. Of course, I here allude to the greenhouse kinds, as those from warm regions differ in their requirements. When the fronds begin to grow, the atmosphere must be kept moist, and the plants should be syringed gently over-

head at least twice in the day, morning and evening, and an occasional dewing in the middle of the day will do them no harm if the sun does not shine upon them. This will prevent the thrips gaining a lodgment on them. The following are the best known kinds:

D. Arborescens.—This is a rare plant in cultivation, and it has always been so. I have frequently in years gone by had branched stems and plain ones introduced, but never got them to live, and I am inclined to think it was from keeping them too warm. This plant is found peculiar to the island of St. Helena, where it grows from 6 ft. to 18 ft. high, the crown densely clothed with long amber-colored silky hairs; the fronds attain a length of 6 ft. It was upon this species the genus was founded, and I cannot agree with those authors who join with these arborescent kinds such plants as the *Dendrostictas*, which have creeping rhizomes.

D. Antarctica.—This is the commonest tree fern in this country, and certainly the most useful. I have no doubt that in many parts of Ireland and in the west of Scotland and England it would succeed if suitable protection was afforded it. In the indoor cool fernery it forms a magnificent object. The fronds are beautifully arched, dark green on the upper side, paler beneath, the crown furnished with ferruginous hairs. Native of Australia.

D. Fibrosa is said by many to be the New Zealand form of the last named species, but under cultivation there are slight differences—the stem is always shorter and the fronds have a rigid appearance, which the true *D. Antarctica* has not. It is neither so effective nor so beautiful as the last-named plant, but it may be grown in a collection with much advantage.

D. Squarrosa.—This is the Table top Fern. The stems are slender and black, the fronds being very rigid and deep green on the upper side, paler below. It is a very handsome species from New Zealand.

Besides the above there are *D. Berteroana* from Juan Fernandez, and *D. Sellowiana* from South Brazil. Both these species, I believe, I have seen in the nurseries of Messrs. Veitch, of Chelsea. There are one or two others which I have only seen in a small state and cannot say much of, but they certainly are worth

DICKSONIA ANTARCTICA.

seeking for and adding to a collection. They are *D. Deplanchei* from New Caledonia, *D. lanata* from New Zealand, *D. Youngia* from New South Wales, and *D. Brackenridgei* from the island of Samoa. The last I have not seen, but I am told it is very near to *D. Berteroana*.—*Wm. Hugh Gower, The Garden.*

SPONTANEOUS CONVERSION OF ISOPRENE INTO CAOUTCHOUC.*

By WILLIAM A. TILDEN, D.Sc., F.R.S.

ISOPRENE is a hydrocarbon which was discovered by Greville Williams many years ago among the products of the destructive distillation of India rubber. Later, in 1884 (*Trans. Chem. Soc.*, xlv., 410), it was observed by myself among the more volatile compounds obtained by the action of a moderate heat upon oil of turpentine and other terpenes. It is a very volatile liquid, boiling at about 36°. Its molecular formula is C_5H_8 , and it forms a tetrabromide, $C_4H_7Br_4$, but no metallic derivatives, like the true homologues of acetylene.

Bouchardat (*Comptes Rendus*, lxxvii., 654, and lxxxix., 361 and 1117) observed that when isoprene is heated to a temperature near 300°, it gradually polymerizes into a terpene which he called di-isoprene, but which is now usually called *dipentene*. This compound boils at 176°. A quantity of colophene similar to that which is produced by the action of heat upon turpentine is formed at the same time.

When isoprene is brought into contact with strong acids, aqueous hydrochloric acid for example, it is converted into a tough elastic solid, which has been examined by G. Bouchardat and by myself; it appears to be true India rubber.

Specimens of isoprene were made from several terpenes in the course of my work on those compounds, and some of them I have preserved. I was surprised a few weeks ago at finding the contents of the bottles containing isoprene from turpentine entirely changed in appearance. In place of a limpid colorless liquid the bottle contained a dense sirup, in which was floating several large masses of solid of a yellowish color. Upon examination this turned out to be India

rubber. The change of isoprene by spontaneous polymerization has not to my knowledge been observed before. I can only account for it by the hypothesis that a small quantity of acetic or formic acid had been produced by the oxidizing action of the air, and that the presence of this compound had been the means of transforming the rest. The liquid was acid to test paper, and yielded a small portion of unchanged isoprene.

The artificial India rubber, like natural rubber, appears to consist of two substances, one of which is more soluble in benzene or in carbon bisulphide than the other. A solution of the artificial rubber in benzene leaves on evaporation a residue which agrees in all characters with a similar preparation from Para rubber. The artificial rubber unites with sulphur in the same way as ordinary rubber, forming a tough elastic compound.

The constitutional formula of isoprene is not known with certainty, but it must be selected from the five following formulæ:

It is obvious that compounds such as these containing doubly linked carbon may polymerize in a variety of ways, and in the present condition of our knowledge of the constitution even of isoprene, it would be idle to speculate as to which out of the numerous possible arrangements would correspond to the constitution of caoutchouc.

THE CONSTITUENTS OF EUCALYPTUS OILS.

By H. HELBING and Dr. F. W. PASSMORE.

THE conflicting statements that are continually made concerning eucalyptus oils, especially those employed for medicinal purposes, render it desirable the principal points in their chemical composition should be clearly indicated, as far as known, in order to avoid confusion, and also to place one in position to judge for himself of the veracity or falsehood of statements that are constantly published, not only concerning eucalyptus, but other essential oils that come into universal use.

Although it cannot be denied that the publication of misleading representations has greatly retarded the progress of knowledge concerning the chemistry of essential oils, the subject is undoubtedly one that has taxed to the utmost the skill of experienced investigators, and it is no discredit that older chemists were unable to accomplish a task that has only been rendered practicable by the resources of the modern laboratory. The enormous amount of literature that characterizes the subject is sufficient evidence of the labor that has been expended in such investigation; but the greater part of the results were rendered invalid through the inability of the investigators to obtain either pure products or characteristic derivatives of the compounds entering into the composition of essential oils. Exceptions must be made in favor of the researches of Berthelot, Tilden, Gladstone, Armstrong and a few others, but even these, valuable as they are, were of so isolated and disconnected a character they did not greatly aid in extension of general knowledge.

The merit of having first introduced a systematic course of investigations into this dark chapter of chemistry, and the satisfaction of seeing valuable fruits from the enterprise and stimulus given to further research in the same direction, must be accredited to Wallach, with whose name is associated a host of others whom he inculcated with his ideas and methods. It is therefore obvious that a consideration of the chemistry of the constituents of the essential oils in general would practically involve little more than a recapitulation of Wallach's researches during the last decade, and as this has been so recently and admirably done by Wallach himself in an address delivered before the Berlin Chemical Society (February, 1891), we shall only attempt to deal with those facts that have direct bearing on the chemistry of eucalyptus oils.

TERPENES.

Like all essential oils, those from the different species of eucalyptus contain varying quantities of terpenes. The terpenes, as may be recognized from the termination "ene," are hydrocarbons, and although generally reckoned among the aromatic series, present certain peculiarities that distinguish them from ordinary aromatic hydrocarbons, although their molecules are undoubtedly correctly represented by the ring structure. These differences are very apparent from their unstable nature and the readiness with which they are convertible one into another, or into bodies of allied composition, by the influence of chemical reagents, or by physical conditions.

This instability has been the chief difficulty necessary to overcome in securing in condition of purity for purposes of characterization and comparison, for so readily are the changes effected, and so closely do many of the terpenes approximate each other in physical characteristics and behavior toward chemical reagents, that it has been frequently found what was regarded as a definite compound was but a mixture, and that the supposed process of purification had effected the decomposition of the original substance. In consequence, nearly every fresh investigation of essential oils at one time led to the fancied discovery of a new terpene that differed in some minor detail from any that had been previously isolated; thus the number of terpenes appeared to be "legion."

Systematic research has now, however, reduced the number of terpenes proper (that is to say, those represented by the formula $C_{10}H_{16}$, which are recognizable by some specific chemical test) to about nine or ten, although all these have not yet been obtained in an absolutely pure state, and consequently the identity and nomenclature of some have been disputed. There is little doubt, however, that at least nine isomerides do exist, and possibly more, but experience has taught the existence of new terpenes should only be accredited when very distinct and corroborative proofs are forthcoming. But besides the true terpenes there is a far larger class, mostly polymerides of the substances represented by the formula $C_{10}H_{16}$, which are also included under the general appellation of ter-

* Paper read before the Philosophical Society of Birmingham, May 18, 1892.—*Chem. News.*