his position. except that his testimony is given under oath. This places a great restraint on his direct testimony, and enables the opposing counsel to test the validity of his views by cross-examination.

There is yet another way of disposing of the difficulties of the case. It is to have experts called by the court directly, and paid by it to assist it in its deliberations. At present experts are to all intents and purposes assisting counsel. This would make them assisting judges. The idea of thus using them is quite a popular one. Many of our best lawyers advocate it. The expert would occupy a wholly disinterested position, and the decisions he reached would have every chance of being equitable and just. In this suggestion there is much that is attractive, and in a more advanced state of society it would seem worthy of being carried out.

But the same necessity which calls for advocates and lawyers to argue separately each his own side of a case calls also for experts on the separate parts of complainant and defendant. When two people come to an issue they do not go before a court and accept its unaided judgment as infallible. Each side engages its own counsel. These are officers of the court, yet are not prohibited by that fact from taking one side or the other of a case. Their duty is to do so, and be as one-sided as possible, and to carry every possible point in their client's favor. No matter how able the judge may be, his time is too important to be devoted to looking up authorities and to studying each from the books. He sits in judgment upon the views presented him by counsel. If they are properly put forward, he in many cases can decide the case without leaving his seat. Thus business is expedited, and the main expenses of a suit are borne by the interested parties and not by the government.

Were the court to call an expert for its guidance in special suits, and were the parties in the suit to have none, the position would be analogous to that of a court sitting in direct judgment or arbitration, with no lawyers to advocate the causes of those appearing before it. There would be no summary of the scientific questions presented. This work would fall upon the court and its expert. Business would be delayed, and a very considerable expense be placed upon the court. It would not be much better to dispense with experts than to dispense with counsel.

At present the scientific views are well presented. The experts give them in detail. They are formulated after discussion with their counsel. The counsels in their briefs and arguments summarize them, and present to the court their most salient and applicable points. The expert has been debarred by his position of witness from arguing the case. Any tendency he may exhibit in his testimony toward such a course is met by objection from the opposing counsel. All he has been able to do is to give his views as a specially qualified witness. The counsel completes the work the expert has begun. He can give the fullest license to his reasoning powers in proving his case. The argument is the supplement of the expert's testimony, and has therefore to follow it very closely. A departure from any of the views brought forward by the expert will be made to tell forcibly against the same side.

Thus it will be seen that the lawyer and expert must work hand in hand. One cannot go ahead without the other, the witness being the most restricted on account of his position. While his testimony must bear the stamp of independence, it will necessarily be partial. As this partiality is known and recognized as an attribute of expert testimony, it gives the professors of it a known standing. They are considered with justness as specially educated witnesses retained for the purpose of presenting the views of one side to the court. They should not be considered as sailing under the false colors of a pretended disinterestedness.

THE CATERPILLAR AND ITS ENEMY.

The ordinary caterpillar is covered with bright yellow hair, has a deep brown stripe down the back, has four tussocks, or tufts, of hair in a row back of its head, and has two small red warts on the two segments next the last. From the extremity projects a single pencil of hairs, and from the head radiate two pencils having the appearance of horns. The eggs from which the caterpillar, or grub, is hatched are small, white, and hard.

When the grub emerges it commences to feed, bending all its energies toward gorging itself. It grows rapidly, shedding its skin several times, and when full sized, or full fed, as it is termed, is ready to spin its cocoon and enter the pupa or chrysalis state. The hairs of the body are woven in the cocoon in addition to the thread spun. The female case is longer and thicker than that of the male. From the cocoon emerges the moth known as the *Orgyia leucostigma*. The females are wingless, having only rudimentary wings, and do not travel any distance. The males are smoke colored with spotted wings. The female lays about 230 eggs, covering them with gluten and a silk which she spins, so that the nest has the appearance of a little tuft of white cotton. She sometimes draws leaves around the nest so as to completely close it, excluding the rain and deceiving the eyes of the birds.

The ichneumon fly is a parasite, its prey being the caterpillar above described. The female deposits its eggs on the back of the pupa in the cocoon of the caterpillar. When the egg is hatched the grub works its way down into the pupa, on which it feeds. When full fed it spins its cocoon in which it completes its transformation, coming forth as a fly. The fly is slim bodied, about one-half an inch long, and of a black color. In some species the antennæ and legs are red, but in the one under consideration the antennæ are black with the exception of the center, which is white.

There is no way by which the worm-pest can be got rid of, and although this fly aids in the work of destruction, his numbers are too small to make his efforts appreciable. Undoubtedly the best way yet devised is to brush off and destroy the nests of the moth. Generally they are easily seen, and when it is remembered that each one contains more than two hundred eggs, it is easy to conjecture what an inroad one man could make in the ranks of the caterpillar.

SKETCHING FOR MECHANICS.

While the value of a knowledge of mechanical draughting to a mechanic is indisputable, there is a sort of free hand drawing, or sketching, that is also useful. The faculty for its practice may be innate, and in that case but slight instruction is necessary to enable its possessor to illustrate his thought far better than he could impart it verbally. But even those whose natural tendency does not impel them to sketching as explanation can get enough facility by practice to make themselves understood readily.

Probably nothing is more difficult to explain and exhibit by words alone than mechanical construction and mechanical movement. It is not only difficult for the narrator, but also for the listener. The memory must hold all the points of the information in contact ready to make a completed idea at the climax. But an appeal to the eye, however crudely made, presents the entire image at one view without any laborious action of the mind. And it is a noticeable fact that those mechanics who are of an inventive, improving, and originating turn of mind are most apt with pencil and paper, or chalk and slab. To them the mechanical idea has received a form in their own mind, and by a partial representation they seek to impart their knowledge to others.

The practice of sketching as illustrative of verbal statement is an excellent one for mechanics generally to acquire. If one has not the natural impulse in this direction, a few lessons in free hand drawing will not be amiss. Some of the best of James Watt's improvements derive their historical and mechanical value from his rough sketches, which told much more plainly than his equally crude English the operations and conclusions of his constructive mind. In the annual meetings of mechanical engineers there is seldom a paper read that is not illustrated by the author, at the time of reading, by the blackboard and chalk, or else it had been made visible by prepared cartoons, or possibly lithographed charts. Shop work also demands the ready hand at sketching. There are many jobs which do not require the preliminary preparation of the draughting room, that are greatly expedited if the foreman has a facility with pencil, crayon, or chalk.

PICKER FIRES

A writer in the *Textile Record* for July asserts that a fire cannot be started in a picker house by sparks of fire from the picker igniting the cotton; "no spark from a picker ever fired a mill or ever can be made to set fire to anything." As the writer well says, "these are tolerably broad assertions." Nevertheless, he offers as evidence in favor of their truth the result of experiments which he made, such as producing a shower of sparks from a brick held against the beater, into which was thrust successively shoddy, cotton fiber saturated with benzine, and even lucifer matches. The open hand held against the stream of sparks felt no pain.

The sparks from an emery wheel do not burn the hand, nor ignite the workman's apron or overalls, but each particle is a minute coal of fire, and under favoring circumstances will ignite inflammable and explosive materials. Sparks from a flint and old file will ignite tinder, charred rags, and punk. But to do so the sparks must be protected from the wind. Possibly the experiments made by the correspondent were made with the beater box uncovered, and the lint and other materials and the shower of sparks were exposed to the blast from the revolving beater. It is probable that particles of grit, nails, bits of wire, and similar materials do run the gauntlet of the picker beaters frequently without inciting a blaze, as the condition of the waste proves; but there may come a time when, all the conditions being favorable, the destructive spark will do the work.

The writer attributes fires to the spontaneous combustion of oily waste which is put into the picker house. If such a reprehensible practice is followed, or allowed by a mill superintendent, he is certainly an unfit man for his place.

It is not always possible to ascertain the cause of a fire that starts in the picker room, but that mills are burned by fires started there is unquestionable. Mill owners show their belief in the danger from this source in erecting detached fire proof buildings for picker houses, and it is doubtful if a single mill owner could be found so confident in this correspondent's belief as to allow experiments be made in his picker house by passing through the rolls to the beater nails, wire, or grit with the cotton. At all events, no degree of the vigilant caution now practiced to prevent these foreign substances from reaching the picker should be relaxed because cotton lint once did not take fire from a shower of sparks.

AN artesian well sunk by the Pierce Well Excavator Company for the Manhattan Elevated Railway Company, at 128th Street corner 2d Avenue, in this city, has a depth of 250 feet, and yields 250 gallons of water per minute.

How to Raise Big Crops.

It has often been asserted by advanced agriculturists that if wheat, either spring or winter, is sown in drills, far enough apart to admit of using a horse hoe between the rows, both to keep down weeds and loosen and aerate the soil, the yield might be increased to a marvelous extent more than it now is in this country.

In proof of this, a recent observing and intelligent traveler in Belgium gives the mode of culture there and the yield, which sometimes, with very favorable weather for harvest, reaches as high as 160 bushels per acre. This is one of the most fertile, prosperous, and most populous countries in the world, supporting 481·71 persons to the square mile, against 13·92 in the United States and 216·62 in Germany. Winter wheat is a staple crop there on their high priced small farms of only an acre or two. The land is highly manured in Autumn, well harrowed several times, and got into the best possible condition. The grain is sown in the fall in seed beds, very thickly on the highest and best location, where it is not likely to be winter-killed, or injured by any casualty, such as overflowing or drowning out, or smothering under the snow.

In the spring the main fields are again dressed up and marked out in drills the proper distance. When the wheat has grown sufficiently to be moved, it is thinned out by being taken up, separated from the thick stools, and planted in the drills with a tool called a dibble, which makes a hole the proper depth, into which the wheat roots are inserted, pressing the earth tight against them with the foot. This work is usually intrusted to half grown boys and girls, a man sorting out the wheat plants in order that those of the same size may be placed together, that the field may grow even and regular.

When the plants have commenced growing, the soil is thoroughly and constantly stirred, either by means of hand or horse power. Every weed and all foreign plants are destroyed, and nothing but what is wanted, the article itself, is allowed to grow. There are very seldom any extensive failures of crops thus carefully and scientifically grown. The yield is a quantity never imagined or heard of in this country, and the crop always and surely pays the cultivator.

It is asserted that such pains would not pay to apply to crops in this country. But do we not go to the opposite extreme? Has it ever been tried here? It certainly would pay satisfactorily if applied to choice varieties in small quantities, about to be used for seed. It is certainly better to till one acre and get a crop now raised on four acres, than to try the four and only raise half a crop, which is now so often the case here.—*Milling World.*

The Water Jet.

The *Annales des Travaux Publics* describes the method used in sinking the piles for the foundation of the Palais de Justice at Brunswick (Prussia).

A framework with hoisting fall somewhat similar to the ordinary pile driver was used in placing the pile in position ready for sinking; two tubes, each 2 inches in diameter, with the lower ends bent inward toward the point of the piles, were attached to the piles by iron staples; at the upper end each pipe was connected by a short section of rubber hose to other pipes connected with the city water main, which water supply was in this case under a pressure of four atmospheres. The piles usually sunk by their own weight into the hole formed by the water jet, as soon as the valve was opened, making connection between the tubes on the pile and the water main. To hasten the rate of settlement, a vertical iron bar 3 feet long was set into a hole bored in the head of the pile, and upon this were placed iron weights of 200 pounds each, as the resistance might require.

Piles 12 inches in diameter were sunk in this way to a depth of fifteen feet in 10 minutes' time. The least time required for a depth of 15 feet was 2 minutes, the longest time for the same depth was 30 minutes. As long as the water jet was in operation at the foot of the pile it was possible to give the pile rotary motion, and thus facilitate the descent; but as soon as the jet was stopped the pile became immovable. As a proof of their stability a dead weight of 50 tons was applied to some of them, and it was found that their resistance was entirely independent of the time consumed in sinking them.

To sink 20 piles by this method required the use of about 2,000 gallons of water; 7 or 8 laborers were employed, and one gang put down from 6 to 14 piles per day.

Copper for Roofing.

In speaking of the cost of building materials an architect recently suggested the use of copper instead of galvanized iron or "terne" sheets for roofing purposes. He said that copper costs only about double the price of tin, or iron, for the same area of roof, that it is practically indestructible by time, and that even if the building it covers is pulled down the roofing material possesses an absolute value. The price of copper has seriously declined within the past year, and if the supply continues to augment much more, the metal will soon be as cheap as tin.

COTTONWOOD lumber seems to be coming into large use, and for dry goods cases, starch boxes, and similar purposes it is said to be well adapted. One establishment in Ohio, it is said, works into boxes as many as two million feet of lumber annually. For building purposes it is not well adapted, as it is apt to swell and shrink with the condition of the atmosphere.