to produce 150 ohms resistance will be necessary for reflecting galvanometer described on page 434 of " Experimental Science "? A. This wire is exceedingly fine and needs great care in working. One hundred and forty feet will give approximate resistance desired; 33,333 feet weigh one pound.

(5681) W. B. S.—Answer by Prof. C. V. Riley.—The insects sent are the male and female of the common wheel bug or " devil's coach horse," as the species is called by children in the South, Prionidus cristatus, Fab., referred to in most of the older treatises on insects as Reduvius novenarius. It is a very common predaceous insect throughout the Southern States, but I have never known it to occur as far north as New York City. Was it collected by Mr. Sargent or was it sent to him by a correspondent ? The eggs of this insect are laid upon the bark of trees, the sides of buildings or on fences, and resemble little leather bottles standing on end and side by side in groups of a dozen or more. The young wheel bug, when it first hatches from the egg, is distinguished by a bright crimson abdomen, which it erects in such a way as to give it a threatening appearance. Upon reaching full growth and acquiring wings it becomes a uniformly dark gray color, resembling in general the color of the bark of a tree. It lives upon caterpillars, grasshoppers, and other soft insects, and its strong beak enables it to pierce even a hard-bodied insect. It captures its prey by stealth, as it is a slow and awkward creature.

(5682) W. S. E. asks : 1. Will you kindly inform me how much hydrogen gas will be liberated by the consumption of one pound of zinc in sulphuric acid ? A. Two sixty-fifths pound, measuring about 10,000 cubic inches. 2. Would gas so made be as suitable for use in a gas engine as ordinary illuminating gas ? A. It would answer, but would be very expensive. 3. What proportions of such gas and air would give the most explosive mixture ? A. Two volumes of hydrogen to five of air.

(5683) K. F. asks : Will two ounces of No. 33 cotton-covered wire produce a stronger electromagnet than No. 24 cotton-covered wire, same amount of wire ? A. No general answer can be given. It all depends on the conditions. At maximum capacity, with similar cores and potential to suit, the power would be equal.

(5684) N. N. asks (1) how to find about the right time of day by a compass when he knows the longitude. A. For such problems we refer you to Gillespie's " Surveying." 2. Winding an electric motor, say ⅛ horse power, to a 110 volt circuit, it would take about 187 watts; the total resistance would be about 64 ohms, if series wound ; the field magnet a little less resistance than armature, say field 26 and armature 38 ohms, 26 + 38 = 64. If shunt wound, the field magnet would be 14 times more than armature; but as the circuit is divided in two, I don't understand how much resistance field and armature could have to make its total resistance 64 ohms. A. Make your field of resistance sufficient to keep the current within safe limits for the wire used, or make it so as to pass the desired current, giving a resistance in this case of 64 ohms. The winding of the armature is based on the desired speed, not on the resistance. Enough turns must be contained to generate counter electromotive force enough to keep the speed down. In other words, it must be wound so as to generate 110 volts at the maximum speed. Calculate as if for a 110 volt dynamo. 3. One pound of water decomposed into oxygen and hydrogen. What explosive power has it in comparison to common dynamite ? A. About 37 atmospheres or 550 pounds per square inch of pressure is given by the exploding gases, about 1/300 the power of 75 per cent dynamite. 4. How long a time will it take to decompose one pound of water by a dynamo capable of giving a current of 10 amperes and 6 volts ? A. One ampere will decompose 92 micrograms of water per second at 32° Fah. and standard barometer. This is 0·00073 pound avoirdupois. If you use three decomposing cells in series it would give three times this quantity at 10 amperes. 5. About how many vibrations does the armature of an induction coil like the one described in " Experimental Science " make per second ? A. 200 to 500 per second. 6. Have you a book about practical geometry, plain and practical for a beginner ? A. We recommend and can supply at price given by mail: "First Steps in Geometry," price $1.25; " Plane and Solid Geometry," by Bowser, price $1.75.

(5685) F. F. M., Newton Falls, Ohio, says : 1. Many wells here are dug to the rock and then drilled through the rock, the water rising several feet in the dug portion. What causes the water to become soily before a storm ? Soundings show that it is not low water. A. The nature of the soil and methods of finishing the wells should be known to properly assign a reason for the stated action of the wells. It is well known that barometric changes in the pressure of the atmosphere affect some wells. Many blow or draw air and have a disturbance in the water level. As the soil above the rock is subject to water soakage, a change of level in the water by change of air pressure may cause a circulation into and from the soil, carrying the loam into the well. 2. What can be used as sizing or paint for the inside of soft or hard wood pails, so that they will hold gasoline or benzine ? A. Coat the pails with glue having 10 per cent of glycerine, all boiled to consistency that will allow it to be caked when cold. Apply hot with a brush. 3. Does steaming second growth hickory to hasten seasoning injure the wood or make it less valuable for stone cutters' mallets ? A. Steaming will not injure the wood, but second growth or young hickory makes poor mallets. Oak is better. 4. Is there any other way to hasten seasoning without detriment to the wood ? A. Slow air seasoning in logs with the bark on is best.

(5686) L. C. K. writes : I would like to know the efficiency in foot pounds of the best forms of the steam injector, as ordinarily used in supplying steam boilers with water. That is to say, for a given amount of work performed, will the injector compare favorably or otherwise with a compound or triple expansion steam engine ? Or to put it in another form, supposing an injector performs 10 horse power per hour work, what amount of coal per horse power per hour would it require to do the work ? A. The efficiency of the injector cannot be stated as a positive amount, from the various conditions of their use. The exhaust injector may be safely quoted on the positive side of 100 per cent, for it not only derives its power entirely from the waste heat of the engine, but also puts the water into the boiler at the usual temperature from other injectors, and when a heater is also used is equal to adding 150 heat units for each pound of water sent to the boiler. The ordinary injector takes from the boiler more heat units than it returns by the amount of radiation and leakage. Its efficiency may be from 90 to 95 per cent. It cannot be compared to a steam engine, even of the best type, which returns no more than from 16 to 18 per cent of the work value of the steam received from the boiler. As a pound of good coal is equivalent to 330 horse power, in heat units, per hour, the 10 horse power injector will represent 1-33 of a pound of coal per hour theoretically or without loss of any kind.

(5687) F. B., Naples, Italy, writes : In all the books treating the dried fruits I read that it is better for a great deal of reasons the fruits be dried with evaporators or other similar means instead to be dried in the sun. Will you kindly let me know through your respectable columns of the SCIENTIFIC AMERICAN your opinion about this question, since I know there are several American firms which have contracts here for dried cherries which must be dried in the sun. A. In all countries having a moist climate or cloudy and rainy weather at the fruit-drying season, a whole crop may be ruined or injured by a few days of bad weather, so that on any extended scale of business the use of evaporators becomes a necessity in the United States and some parts of Europe. In the sunny climate of Italy and the East the dry air and long terms of cloudless skies, as also old custom, has given the sun-dried fruit a reputation, which is no doubt at the bottom of the preference for that method by American fruit houses. We have never seen finer fruit, either in appearance or flavor, than is produced by the artificial driers in the United States.

(5688) M. S. Y. asks : 1. In the small Gramme ring motor described in SCIENTIFIC AMERICAN SUPPLEMENT, No. 783, would not any very soft iron do, instead of Norway iron, for the field magnet ? A. Any iron will do. 2. What size wire is to be used on field magnet ? A. No. 20. 3. Would solder make a suitable Babbitt metal, and is sheet brass fit for commutator springs ? A. Solder would not answer. Use copper for commutator brushes. 4. What horse power does the motor develop ? A. It has never been computed. It is a very small fraction. 5. Can the parts be enlarged so that it will run a sewing machine for light work? A. They can, but we do not recommend it. 6. How many cells of plunge battery would be required to run a sewing machine? A. Six or eight cells.

(5689) T. W. S. asks : What size and shape of nozzle will give the greatest power under an 80 foot head, using an 8 inch pipe which is 120 feet long ? Would there be any change in nozzle if the head were 100 feet, with pipe 170 feet long ? What horse power should we get at 80 feet head ? A. The nozzle should be slightly taper, after the form illustrated in SCIENTIFIC AMERICAN SUPPLEMENT, No. 792, 3½ inches diameter, which will give you a spouting velocity of over 4,000 feet per minute, and if applied to a 6 foot Pelton wheel should furnish an available 45 horse power. With the longer pipe and higher head a 3 inch nozzle will give best results and about the same power.

(5690) H. T. asks : How high ought a pump lift water at an elevation of 8,000 feet ? What is the difference for each 500 feet from sea level up to any height ? How many inches of vacuum will an air pump maintain at 8,000 feet, and what is the difference for each 500 feet ? A. The loss in pump lift at an elevation of 8,000 feet is 9 2-10 feet with the barometer at mean pressure, or a little over 27 per cent. Assuming the lifting height of ordinary pumps at sea level to be 28 feet, 21¼ feet would be the lift at 8,000 feet elevation. The variation is not a constant for each 500 feet elevation. It is a decreasing ratio. The loss of lift at 500 feet is 1·017 feet, at 1,000 feet 1·64 feet, at 2,000 feet elevation 2·84 feet.

(5691) G. A. L., Mont., says : I want to pipe a small spring 6,000 feet away, having a fall 40 to 50 feet. What proportions of pipe would give the strongest flow, ending with half inch, and would it produce any power? A. The flow of water for long distances through small pipes is of no practical value for power, as the friction absorbs most of the value of the head. With a division of the distance into three parts, with 1 inch, ¾ inch and ¼ inch, will give an open flow of 1½ gallons per minute, from which no power of any value can be obtained with the low head stated.

(5692) L. G. asks : 1. What change is necessary in motor No. 641 to run on a 110 volt circuit ? A. Wind field with 4 pounds No. 25 wire. It would be better to use 5 pounds if you can get it on. The winding of the armature depends on the speed you desire. For a high speed use No. 32 wire on the armature, using the full quantity specified in weight. Finer wire will reduce the speed. 2. Can I make the armature of sheet iron washers with paper between each sheet in place of iron wire ? A. Yes. 3. How can I make lard oil out of old lard ? A. Purify the lard as far as possible, and extract the oil by hydraulic pressure of 1,000 pounds per square inch, the lard being contained in sacks.

(5693) T. S. R. asks if the brush holder (not the brush) of an electric street car motor were to touch the commutator of the armature, would that necessarily "ground" it ? A. If the brush holder of the ground brush did this, it would make a ground; if of the trolley brush, it would make a short circuit. It is not easy to see how any such contact could be brought about except by a piece of metal bridging the interval between brush holder arm and commutator.

(5694) W. H. writes : 1. I have made the small hand power dynamo given in SUPPLEMENT, No. 161, and although it seems to give quite a strong current, it will not run a No. 3 Porter motor with 3 pole armature. Can you explain why I run the Porter motor with 6 cells plunge battery and it gives good satisfaction? I have tried the dynamo on a call bell, and it will ring it louder than the 6 cell battery. Can you tell me whether I can wind the motor so that the dynamo will run it, or wind the dynamo differently? A. It is all a matter of resistance and potential being properly related. We presume that the Porter motor is of too high resistance.

Slightly finer wire on the dynamo might effect the purpose. But it may be the other way. 2. How many storage cells will it take to run the Porter No. 3 motor, and how long will they run it and give as much power as the 6 cell plunge battery? The plunge battery cells have 4 carbons, such as are used in a compound Fuller battery and compound Fuller zinc. A. A storage cell will give 2 volts potential and 10 to 35 amperes, according to size of current, for 10 hours. Two cells should run the motor for a number of days. Five storage cells would give about the same voltage and five to ten times more current than the plunge battery on low resistance. It depends on the size of the cell used. 3. Can I make a plunge battery with less cells and larger plates that will run the motor as well as the six ? A. We have no data as to your motor, and cannot answer the question intelligently. Possibly a large two or three cell plunge battery would run it. 4. How many storage cells would it take to run five or six 16 candle power lights for three or four hours per day, and how much current would it take to charge them ? How large a dynamo and how much horse power if the dynamo were running eight or ten hours per day ? A. Allow 60 cells and on charging 1-20 horse power dynamo of 135 volts potential.

(5695) A. B. C. writes : I have just received a splendid Charcot compound magnet. What must I do in order to maintain its present strength ? I have heard that it is not good to detach the armature suddenly, yet I would like to do that very thing, for I want to test its strength by adding weight to the armature until it is pulled off ? A. Detaching the armature suddenly does no harm. It is the replacing it with a click or jar that injures the magnet. Slide it into place most carefully, and when you pull it off, do so sharply and clearly, so as to prevent any click or jar. Always keep its armature in position when it is laid aside and not in use.

(5696) B. T. S. writes : 1. I am thinking of making a pocket storage battery to last five hours without recharging it, and I would like to know if one gravity battery would be sufficient to charge it. If not, how many would be required, and how long would it take to charge the storage battery ? I have some salt batteries which I run on my telegraph line and are as powerful as a gravity battery. I would like to know whether or not they would charge as well as gravity, if so, how many cells would be required ? A. Three gravity cells in series will charge your storage battery. How long depends on its size ; probably the same time will be required to charge as to discharge. The salt batteries will not answer, as they will polarize too quickly. 2. I have a very powerful magneto-machine, and I would like to know if it would run a one candle power incandescent lamp. If a number of these machines were joined in series, do you think it would light a miniature arc light ? A. You can try your magneto on a lamp, but we are certain that it will not light unless specially built to give plenty of current. The eff.ct of joining in series depends on the winding of the armature. 3. How much wire and what number should there be on the receiver of a telephone and state how to make one ? A. Use No. 36 wire wound to 80 ohms resistance. See our SUPPLEMENT, No. 142, 10 cents by mail.

(5697) Sister C. asks : Why should the ocean be coldest at the bottom ? Why should the Red Sea be warmer than Indian Ocean ? A. The waters of the oceans are at the greatest density at a temperature of 39° F. The difference in density causes the warm water at the equator to flow toward the poles on the surface of the ocean, while the return current from the polar regions flows toward the equator along the bottom of the ocean by its greater density. By the great heat of the sun the surface water of the equatorial regions becomes warm, and flowing away toward the poles, allows the cold water at the bottom to gradually rise to the surface and become warm, thus keeping up the continued circulation of the waters of the great oceans. The warmth of the water of the Red Sea is due to the influx of a warm surface current from the Indian Ocean through the shallow straight of Babelmandeb and the return of a denser salt current, from excessive evaporation, along the shallow bottom and out into the Indian Ocean, thus making the entire circulation of the Red Sea to be derived from the surface warm water of a tropical ocean, and isolated from the cold polar waters flowing at the bottom of the deep oceans. Its tropical location adds the full force of the solar heat to the warm water circulation, making it the warmest of all the arms of the great oceans.

(5698) W. F. W. writes : I want to light one or two rooms by a dynamo, driven by a water motor. 1. Suppose the dynamo will light six lamps of 10 candle power each and three of them should be turned off without change of current, will the other three be injured ? A. Not if the dynamo is self-regulating to a sufficient extent. But a dynamo at fixed speed only works well at its true capacity. 2. Would not lamps of 16 candle power give an 8 or 10 candle power light and last longer with this current ? A. Yes; they will last longer, but cost more to run. 3. How many hours ought a low resistance lamp to give a satisfactory light with a suitable current ? A. 600 hours upward. 4. Are lamps of any value after having become exhausted? A. The platinum is worth something. 5. What size wire should I use for carrying the current, the farthest lamp being about 50 feet from the dynamo ? A. It depends on the amperage of the lamps, which can be deduced from the voltage and candle power. These factors you do not state. 6. If the wire is insulated in the ordinary way, is it necessary to provide any additional insulation where it passes through wood or plaster ? A. Not if gutta percha insulation is used. 7. Is there any simple method for determining the number of revolutions per minute of a water motor ? I wish to find the velocity of a ½ horse power motor with a water pressure of 80 pounds. A. Attach a pencil near its center of rotation. Move a paper mounted on a board in front of and touching the pencil. Keep the board moving for ten seconds and count the circles. 8. About how many gallons of water would a dynamo at fixed speed require to run a motor per hour ? A. About ½ and 1,500 gallons. 9. In experimenting with blue prints I find that a dilute solution of ammonia will give them a very fine purple tone, but they soon change to blue or grayish blue. Can you give me any method by which I can fix and make permanent any desired ammonia tone ? A. You cannot make it permanent.

INDEX OF INVENTIONS