hours. Similar formations have been known to come and go in one-tenth the time. The tremendous velocities and masses involved can hardly be appreciated, for one inch in the figure corresponds to nearly 50,000 miles at the surface of the sun.

The two instruments mentioned are each 80 feet in length and placed vertically in a well of the same depth. These instruments project upward into the observing room about 3 feet to the level *F* (Fig. 2) at which the image of the sun is formed. The light enters either instrument at this point and passes down its length to the bottom of the well. It is there analyzed by either prism or grating and then reflected back a little to the side of *F* where the photographic plate is located. Plates up to 36 inches in length may be used.

Now that we have considered briefly the arrangement and use of the optical parts, we are in a better position to appreciate the general construction of the tower, etc.

One of the difficulties with all telescopes used for refined work is their liability to be shaken by the wind. To provide against this a very ingenious plan was adopted. The tower is double, or rather, there are two complete towers, one within the other, each with its own set of piers and nowhere touching. This can be seen best in Fig. 4, where two complete sections of the light inner tower are in place while the outer tower, which is to inclose the inner, member by member, has just been started, only the lowest horizontal and first vertical members being in position. Each member of the outer tower is of box construction, within which is the corresponding member of the inner tower. All the optical parts above the observing room are supported by the inner tower while the outer carries the dome and complete shields the other from the wind.

The huge concrete piers for the outer tower, eight in number, are in part shown in Fig. 4. The relation of the piers of the two towers is best seen in Fig. 2, the piers for the inner tower being the ones extending just to the surface of the ground.

The erection of this double tower afforded considerable difficulty, as it was quite different from the ordinary structural steel job. The general scheme, however, can be seen from the illustrations. The men worked on platforms suspended on the outside. The steel was put into place by a gin pole and the usual hoisting engine. When a section of the inner structure was in place each member was inclosed by the corresponding box-like member of the outer. Great care was necessary that neither was in contact with the other at any point. A clearance of 3 inches between the two permits considerable vibration of the outer tower without affecting the inner.

The dome is not of the usual type. It consists of two half-domes, one slightly larger than the other. When closed the two halves fit snugly together and afford good protection from the weather. Upon opening, the smaller section can be rotated until it is wholly within the other, thus leaving one side entirely open. In Fig. 5 it is open to its fullest extent. It will be recognized that this dome has about the same relation to the tower telescope that the lens cap has to an instrument of the ordinary type.

Down the center of the tower can be seen a square tube made of sheet iron. About this are placed canvas *louvers* to protect it from direct sunlight. By this means troublesome radiation effects are eliminated in the air column through which the beam of light passes after leaving the lens.

The observing room is shown in Fig. 2. It is at the base of the tower and directly over the 80-foot well. There is a photographic dark room in connection with it. The entire structure is of reinforced concrete.

The height of the tower from the ground level to the floor of the dome is 160 feet. The dome adds 13 feet more, so that the total height is 173 feet. The weight of the steel used in the construction is 150 tons. The eight concrete piers for the outer tower weigh about 70 tons each, while the four piers for the inner tower each weigh 19 tons.

The well, which is 10 feet in diameter, was sunk into the rock before the tower was erected. It is lined with an 8-inch concrete wall. A spiral stairway, as shown in Fig. 2, provides an easy way to reach the optical parts at the bottom of the well whenever these need adjustment. The well has a special advantage in that it has practically the same temperature throughout the year. This constancy of temperature is of prime importance for the prism or grating in the spectrograph or spectroheliograph. Very slight changes of temperature during an exposure which may last several hours are fatal to work of high precision.

The great height of the tower has one advantage not yet mentioned. Anyone looking along a hot street has undoubtedly noticed how an object near the ground seems to be trembling owing to the intermingling of the unequally heated air currents. An object at some distance above the street does not appear to tremble anything like as much. Hence if we increase the elevation above the earth at which the beam of light is received by the lens and then carefully shield this beam by means of the tube of sheet metal, it is possible to get a much steadier image of the sun than if the beam were received near the ground.

An elevator run by an electric motor is used to make the ascent of the tower for opening the dome and setting the mirrors before beginning observations. A ladder is also provided should the elevator be temporarily out of commission, but it goes without saying that the elevator is the more popular of the two.

Electric motors are used to control the movements of the various instruments, the switches being as far as possible directly under the observer's hand. Most of the motors are of the reversible type, as double motions are usually necessary. Eighteen motors are required for the various purposes.

Fig. 6.—Top plan view of the tower and its apparatus.

The great instrument thus briefly described has just been completed. In the hands of Dr. Hale and his co-workers it will undoubtedly greatly aid in solving many of the troublesome problems in solar physics.

Acknowledgments are due to Mr. Ellerman and Mr. Messer of the observatory staff for the excellent photographs used to illustrate this article.

Crop Improvement: A Problem in Increasing Our National Efficiency

By C. M. Carroll

IT is generally conceded by those who know, that science is twenty-five years in advance of its practical application. Unfortunately this lamentable fact applies also to the science of farming, which is our primary base of supply. Since the superstructure of commerce is built upon a foundation of agriculture, commercial development is the logical sequence of agricultural development. Soil, therefore, it seems, always was, and never has ceased to be, the world's principal asset. No one has even attempted to dispute it. Since commerce is simply an interchange of commodities which are produced from the soil, business men cannot say, "Why should we bother our heads about the crops? Let the farmers take care of their own business and we will take care of ours."

"Mind your own business" is an excellent motto, but, so few of us really know what is our own business. Agriculture is so interwoven with the business of us all that it is impossible to find the line of cleavage where one man can say, "This is my business, let me alone."

We are all of us convinced that it is immediately necessary to add to our national wealth by getting more out of the soil. Farming is everybody's business, and woe to the man who says that he is not concerned in the business of farming. We have been carrying no grain surplus, and a single crop failure would put us on almost a famine basis. The United States, from year to year, is becoming less considered in the feeding of other nations, and we are rapidly drifting to the point where the balance of trade will be permanently against us. How are we going to regain the money spent by our tourists abroad, the interest on our bonds and the vast sums which are expended for diamonds and luxuries from every part of the world?

When we look at the ten-acre plots of Europe and behold a larger yield than from a forty-acre American field, we feel that our millions of farmers are in reality no farmers at all; and with the exception of here and there a man who is tilling the soil with thrift and intelligence, the great majority are still robbing the land, and getting less than half of the crop.

In 1910 there were two hundred million acres of wheat, corn and oats harvested in the United States. Our agricultural scientists tell us that we can increase any crop from four to ten bushels per acre in a single season by seed selection and proper cultural methods.

In spite of the excellent and energetic work of the United States and State Departments of Agriculture, the agricultural colleges and extension departments, farmers' institutes, and a thousand other things which are being preached by the agricultural press, the unpleasant fact still remains that twenty years ago the United States raised more than six hundred million bushels of wheat which is about the same amount raised

in 1911, while our population has increased nearly thirty million souls.

Notwithstanding our enormous activities, the average yield of corn per acre is slightly more than thirty-four bushels. Prize corn growers have demonstrated that it is possible to grow two hundred and twenty-five bushels to the acre. The price of flax seed is soaring all out of proportion, and barley is selling for \$1.25 per bushel, for a very poor grade at that. The cost of living is not so high in this country, but it will be higher in the near future if the present tendencies continue. It is common knowledge that vast areas of land in the original thirteen States now lie abandoned. Many farms of the Middle West States are now undergoing rapid soil depletion as a result of careless farming.

Quoted from eminent authority, "The American farmer has learned well the art of agriculture in the hard school of experience, but the science of agriculture is almost unknown to him; and unknown not only to the farmers and land owners, but also unknown to the statesmen, unknown to the local public officials, unknown to the teachers of the common schools, and unknown to the preachers, to the merchants, to the grain dealers and to the bankers."

So it is evident that preaching and the printing of bulletins are not altogether satisfactory.

True co-operation means the greatest good to the greatest number, and upon this basis Bert Ball, secretary of the Crop Improvement Committee of the Council of Grain Exchanges of America, is making an effort to unify and harmonize all of the interests, including the manufacturers of agricultural implements, fertilizers, grain and elevator companies, cereal manufacturers, chemical manufacturers, railroads, bankers, and all other business interests in a National crop improvement plan to co-operate with the U. S. Department of Agriculture and the various branches of the extension department of the State agricultural colleges. Individual effort at cross purposes will not accomplish satisfactory results. The plan covers the development of each county through an amalgamation of commercial, educational, transportation and agricultural interests. It advocates the establishment of trained agriculturists in each of the counties of all of the agricultural States in connection with the United States Bureau of Farm Management, State agricultural colleges, State commercial associations and local commercial clubs.

The National fund for this purpose is now being raised in order to offer \$1,000 or more to each county in each State, and State commercial organizations are ready to form State crop improvement associations to raise a like amount to that offered to each county from the National organization. This fund has been started with one million dollars by Messrs. Sears, Roebuck & Co., of Chicago, who have set aside the sum \$1,000, to be given to each of 1,000 counties in every State which will raise a fund locally, sufficient to employ a permanent county agriculturist and farm demonstrator.

The Government Bureau of Farm Management also has a fund, and offers to bear from one third to one half of the expense of this Farm Bureau in any county the plans of which are acceptable as soon as its funds become available for this year. This will add approximately another \$1,000 to each county ready to raise its own fund.

While there are scarcely any two counties operating under exactly the same plan, the following is the one recommended by the Crop Improvement Committee.

First: That a joint meeting be called by the commercial organization or organizations, to which there will be invited editors, railroad men, road commissioners, superintendents of county schools, superintendent of the county farm, the county supervisors (commissioners of county court, as the case may be), bankers, millers, manufacturers, grain buyers, officers of all farmers' and breeders' organizations, the leading farmers and land owners in each township. This meeting to be conducted by a member of the Crop Improvement Committee of the Council of Grain Exchanges, explaining the nature of the movement.

Second: That a committee on crop improvement and county development be appointed by the president of the commercial club: that the members of this committee shall act ex-officio as chairman of the sub-committees on ways and means, membership, grain, good roads, marketing, agriculture in the schools, dairy inspection, landlord and tenant, etc.

Third: That a special section be added to the constitution and by-laws of the commercial club providing for an agricultural membership at a nominal fee per year, in order to obtain a widespread special membership, placing the farmer upon a business basis, establishing him as a business man among business men.

Fourth: That the sum to be raised in each county should equal annually one cent per acre of all the tillable land in the county, or a minimum of \$100 to be subscribed by farmers, landowners, elevators, country merchants, professional men, blacksmiths, hotels, etc., in each township.

(Section Four, like the whole plan, is elastic, and may be changed to fit local conditions.)

Fifth: That an equal amount be contributed by the commercial club, merchants, manufacturers, bankers and business interests of the country which shall not be less than a minimum of \$100 for each township in the county. This divides the financial responsibility equitably.

Sixth: That a trained agriculturist of business tact and judgment shall be employed by the committee as above set forth, who shall be recommended by or satisfactory to the State College of Agriculture.

That this man shall be responsible to the local committee, according to the terms of his contract.

That he shall be employed for not less than two years, and preferably for three years.

That the commercial club shall establish an office for him in a suitable location, preferably with the commercial club.

That he must submit his plans to the local committee from time to time and report the progress of his work, a copy of which shall be furnished to the newspapers in the county, with a request that they be printed in advance.

His duties shall consist in general as advisor to any farmer in the county requiring his services; to organize farmers' clubs; to conduct corn clubs and other agricultural contests; to arrange for exhibits of agricultural products; to give practical demonstration and instruction in crop rotation, soil building, farm management, and horticultural work in various parts of the county under ordinary conditions; to co-operate with the State Agricultural College and the superintendent of county and city schools as well, in teaching the rudiments of agriculture, particularly of seeds, so that the children may ultimately test all of the seeds to be planted on each farm in each school district.

That the children of the public schools shall be furnished with crop report blanks between harvest and seeding time, and each pupil be induced to obtain a written statement upon these blanks by a different farmer stating the number of acres devoted to each crop and the annual yield as per directions furnished.

That these reports shall be classified and the results tabulated and published by the committees in charge, the object of which is to learn not only the total yield of the county but how much each individual adds to the total.

Seventh: That the manager lay out a practical schedule of farm practice for the county poor farm which shall be acceptable to the county supervisors, with a view of putting the farm on a self sustaining basis. It shall be his duty also to establish seed plots, both on the county farm and in the various parts of the county on private farms to breed up to the highest efficiency the variety of seed wheat, corn, oats, barley, rye or other products which may be best adapted to the soil and climate of the county, so that eventually a single uniform variety and grade of each grain may be established which may be shipped in carloads free from mixture of other grains and the seeds of noxious weeds.

Eighth: While it is not incumbent upon the local committees or of the manager of the county farm bureau to put all of these recommendations into immediate practice, it will define a line of procedure which will enable the county committee and Crop Improvement Committee of the Council of Grain Exchanges to make a satisfactory agreement.

The International Electrotechnical Commission

PROPOS of the general meeting of the International Electrotechnical Commission held at Turin in September, the London *Times* publishes a review of the valuable work which the commission has taken up since it was organized, in London, in 1906. Up to 1908 only ten countries were active adherents, but now twenty countries are taking part in the proceedings.

An unofficial meeting of the commission was held in Brussels last August, under the presidency of Prof. Eric Gerard, at which much progress was made toward the solution of many problems upon which international agreement had become an increasing necessity. One of these was the establishment of international symbols for the various electrical quantities. The Elektrotechnischer Verein, of Berlin, which represents all German-speaking countries, having adhered to the recommendations of this meeting, it is altogether probable that at Turin the symbols I, E, and R, familiar to English-speaking physicists, will be universally accepted for the simple representation of Ohm's law.

It is also expected that international agreement will shortly be reached as to the rating of electrical machinery, i. e., the tests to which such machinery must conform before being put to actual use.

A small international committee, which met at Cologne last May, has made a substantial beginning in the matter of industrial electrotechnical terminology in French and English, the official languages of the commission. The committee agreed to some fifty industrial terms and definitions.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Compressed Air to Prevent Foundering

To the Editor of the SCIENTIFIC AMERICAN:

Your daily mail now probably contains hundreds of letters setting forth impossible and impractical ideas of what should have been done to have made the "Titanic" really unsinkable.

I presume an idea I advanced in a letter to you over twenty years ago is an impractical one, or it would have been adopted in some form before this.

The idea was to connect each water-tight compartment through an opening in its upper part or ceiling with a powerful air-compressing plant. A few moments would suffice to give any broken compartment an air pressure that would prevent water rising above the break in its side. If your picture in this week's paper is correct, this plan would have kept her afloat.

North East, Pa.

A. I. Loop.

A Plea for Wireless Investigation

To the Editor of the SCIENTIFIC AMERICAN:

The public has recently been agitated by the failure of the papers to get news of the "Titanic" disaster. A reason had to be given the public for this delay. The blame was laid to the parties least able to defend themselves, as is usually the case. At once great headlines flared forth the atrocities of the "Wireless Meddler."

To put aside all consideration of causes other than that of amateur interference, let us consider the case of the amateur from his side of the fence.

Who is the amateur—the high school boy or the advanced experimenter? High school boys are not very apt to cause trouble by high-powered sets, nor are the advanced experimenters going to interfere with important messages, knowing as they do how dependent they are upon the good will of the Government stations. The amateur, with a low-powered set and short wave, can be avoided unless the other station is also using a very short wave. Up-to-date commercial sets have long wave lengths, and are able to get rid of the "kids" with satisfaction.

As to the amateur himself, no investigation conducted along sane grounds could be too welcome. The navy and commercial operators are both prejudiced. One would like complete control, the other likes no control at all. Investigation by such a man as Prof. G. W. Pierce of Harvard, or by some other scientific expert of known worth, would lead to regulation of some kind, but regulation that would not be prohibitive to the experimenter. The idea of completely killing all experimenters, which the navy is fostering with care, is absurd to a rational thinker. Yet every means is being turned to this very end. Whenever an operator in one of the Government stations has any difficulty with his apparatus, or misses out on a message through his own inability, a very simple and efficient excuse is, "Couldn't get a thing through the amateurs."

What the amateur wants is investigation, not a lot of operators' opinions, all of which are sure to be distorted, according as they are Government or commercial, but investigation by a third party of known repute, preferably a college expert. Then such regulation as is recommended will be received with satisfaction, at least by those wishing a square deal to all concerned.

Cambridge, Mass.

H. E. Rawson.

In Defense of the Amateur Wireless Operator

To the Editor of the SCIENTIFIC AMERICAN:

I have long been a friend of, and a subscriber to, the SCIENTIFIC AMERICAN, whose fairness, and care in making sure of the truth of statements before publishing them, has especially appealed to me. It is with much regret, therefore, that I note the unfriendly attitude taken by you toward the independent wireless experimenters, and am sure that this attitude would be quickly changed if you had a wireless station of your own, were familiar with practical operating, and heard with your own ears what is actually going on in the ether, as I do every day. With the equipment at my station I am able to hear the Government and commercial stations, and ships along the coast, all the way from Portsmouth, N. H., to Key West, and the facts revealed by listening to what is going on in this wide field are these: The commercial stations and ships are constantly operating, receiving, and sending messages at high speed, and usually without trouble or repetition. One can listen to them night after night, without hearing a case of interference.

The naval stations operate at an average speed of about twelve words a minute, and it is the exception rather than the rule for one of them to receive a message without having it repeated in whole or in part.

One night recently a friend and myself were listening

in (using two sets of phones in series) and heard Baltimore send a message to the Washington navy yard, which we received without difficulty. After some time the navy operator said: "Please go ahead a little slower;" and Baltimore thereupon repeated the message slowly in perfect Continental. The navy yard then got part of it, but asked him to repeat a portion of the middle. This time the navy operator got a word or two more, but had to have the message four times before he got it all. No other station was sending at the time, and there was very little static. On another occasion the navy operator at Norfolk, after trying several times to get a message through to Washington at a rate of about five words a minute, gave up in disgust, and said: "For the love of Mike, get an operator." On still another occasion, after the naval station at Annapolis had made several futile attempts to receive a message, the navy yard here broke in and said: "Say, old man, send it to him slow." This was done with better results.

A dozen pages might be filled with similar incidents, which are true, to my personal knowledge. It is also true, as your correspondent, Mr. Powell, states, that private wireless stations here often copy messages which the navy yard is unable to receive. I know this to be a fact, for I have done it myself.

In view of this condition, it is possible to understand how such statements as yours of the front page of the issue of March 23rd came to be published. The Government operator, an amateur himself, fails to receive a message, and an explanation being demanded by the officer in charge, he must have an excuse or get into trouble; therefore, he says that amateur stations interfered with him.

The difficulties the "Titanic" had in communicating with the "Carpathia" in mid-ocean were explained in this way to the full satisfaction of newspaper editors; and Siasconset wireless station could do nothing for forty-eight hours, though situated far out at sea, with nothing near but a fishing hamlet!

The latter case calls to mind the letter from Donald P. Beard, published in your issue of May 4th, and it is hard for one conversant with the facts to restrain his indignation upon reading such a letter. The writer hints that the suppression of private wireless stations would secure secrecy. He is evidently unfamiliar with the fact that any operator can connect his instruments between his iron bed and the radiator in his room, and receive messages from stations hundreds of miles away. I know this can be done, for I have done it. The only possible way to prevent "interference" of this kind is to have a Government inspection of every room in the United States. We recommend this to the attention of your Missouri correspondent! As for that writer's statement that the Government equipment is of the "most advanced and delicate type," it is quite evident that he has never compared an old outfit, such as the navy yard here has, with a perfected apparatus like the recent multiple tuner now in use in Marconi stations.

Mr. Powell was absolutely correct in his statement that the listening amateur operators insure the receipt of distress calls, and thus constitute a great safeguard. I believe in this from the large number of calls that are never heard by the Government and commercial stations. While experimenting with my receiving set at a point on Buzzards Bay, Mass., I once heard a ship call every naval and commercial station from "N. A. G." (Fire Island, N. Y.) to "B. H." (Boston), inclusive, also several ships, for an hour, without getting a reply. Suppose this had been an urgent distress call? That ship would have gone down with the call unanswered unless I or some other "meddler" had given the alarm.

This does not necessarily mean that the regular operators were neglecting their duty. Some may have taken off their 'phones to rest, and others may have been "listening on a different tune." But it does demonstrate that the only safety lies in having as many operators as possible on the job.

While a complete defense of the wireless amateur operator, or a technical explanation of why such stories as that of Siasconset and Gresham interference are untrue, cannot be made within the bounds of one letter, the writer hopes that the foregoing facts will have some weight with the Editor of the SCIENTIFIC AMERICAN. They were not obtained second hand, or from newspaper report, but are true, to the personal knowledge or the writer, who is a credible witness, and will be pleased to testify to them under oath.

Of course, no one can deny that it is possible for a private wireless station in the vicinity of a Government station to interfere with the latter, and this interference sometimes takes place, and therefore some form of regulation by law should be had; but it would seem to the writer that the law need only provide for the licensing of such private stations as are near enough to the Government stations to be actually capable of interference, thus leaving thousands of those which are back in the country, and cannot interfere, free to operate and develop the new means of communication unhampered. Would the SCIENTIFIC AMERICAN give its support to such a bill?

JOHN V. PURSELL,

Tennallytown Station, Washington, D. C.