THE TELEPHONE.

One of the most striking characteristics of the present age is the marvelous rapidity with which useful inventions are introduced. The telephone is a striking example of this. The first public exhibition of the telephone was in the year 1876, at the Centennial Exhibition in Philadelphia. In the following year the first telephone exchange was established in Boston with five subscribers. With extraordinary forethought, the primitive switchboard illustrated in our cut was made long enough to contain switches for five subscribers in addition to those who originally joined the exchange. It soon became evident that the telephone system was destined to extend more rapidly than was at first believed possible, and the original switchboard was never filled up, but was supplanted by a more comprehensive arrangement.

To give an idea of the rapid development of telephonic communication, it may be interesting to show how the Boston exchange has grown to its present proportions. It has many times outgrown its quarters, and besides the principal exchange, there are now two branch offices and seventeen suburban exchanges in direct connection, and more than two hundred cities and villages in New England may be reached by telephone from Boston. The new "central office," which we illustrate, is furnished with the latest form of multiple switchboard, manufactured by the Western Electric Company, in Chicago. The capacity of this board is 3,500 lines, and together with the two branch offices gives Boston a capacity for nearly 6,000 lines. The number of subscribers in Boston, April 1, 1884, was 2,386. Taking the increase in the United States, the figures are even more startling. In May, 1877, there was but one exchange with five subscribers; in January, 1884, there were 906 exchanges, with 123,625 subscribers.

Although the telephone has attained its present importance within the last decade, and the first announcement of Professor Bell's invention must still be fresh in the memories of most of our readers, yet a concise history of this wonderful invention will not be out of place.

The credit of first conceiving the possibility of transmitting articulate sounds by electricity is due to Prof. A. Graham Bell. His familiarity with the applied sciences, particularly acoustics, dates from early youth. He was instructed by his father, who was engaged in the difficult task of teaching the deaf to articulate, in the physiology of the human throat and ear. Even when quite a boy, young Bell had ingenuity enough to construct a talking machine which would utter one or two simple words. About ten years ago Prof. Bell was engaged in increasing the efficiency of the electric telegraph by employing the vibrations of reeds of different pitch in connection with the usual telegraphic apparatus. While engaged in perfecting his system of harmonic telegraphy, he conceived a method of making a complicated receiver, consisting principally of a set of reeds of different pitch, giving forth tones corresponding to those entering a similar transmitter connected by an electric current with the receiver; much as the strings of a piano will respond to the human voice. Coupled with the then recent discovery of Helmholtz, that the vowels and other vocal sounds were simply the combination of several elementary notes, Prof. Bell at once perceived the possibility of transmitting speech.

It only remained to try the experiment, and to improve and simplify the apparatus, in order to make his invention practically useful in every day life.

Immediately on the publication of Prof. Bell's success in transmitting speech by electricity, the whole scientific world turned with interest to the new wonder. Many improvements were soon made in the details of the telephone; and other inventors, as Edison and Blake, produced transmitters of greater power and better suited for actual service than Prof. Bell's instrument. As a receiving telephone, however, Prof. Bell's invention is in universal use in almost the exact original form, and it seems unlikely that it will be superseded by any other receiver, so perfect and simple is it at the present time.

The extent and variety of experimental work for improving the telephone now being carried on by the American Bell Telephone Co., and the facilities which they possess for continuing this work, are not generally known, and it is our object to illustrate and describe these facilities. Inventions connected with the telephone are continually being offered to the company, and those which appear to have merit are carefully examined, and adopted or rejected according to their value. Often those inventions which are purchased by the company require more or less modification to adapt them to practical use. To successfully carry out the objects indicated above, the company employs a corps of expert mechanics and others skilled in the principles and practice of electricity and its allied sciences, and has provided an experimental shop, a chemical laboratory, and an electrical testing-room, fully equipped with the necessary machinery and apparatus. The experimental shop, well shown in the illustration, is remarkably well supplied with such tools as are required for producing and altering electrical apparatus. It has a full complement of iron and brass working machine tools, carpenters' and mechanics' benches, forges, and other mechanical appliances. Power is supplied by a gas engine.

In addition to this purely experimental work, the department is continually making tests of samples of wires, of insulating material, and of supplies of various kinds, both as a basis of purchase and to maintain the required standard of quality. For these purposes special apparatus is provided where it is required; as, for example, tensile and torsional wire-testing machines. Perhaps the most important tests made are those upon the telephones and transmitters manufactured for the company by the Western Electric Co., of New York, Chicago, and Boston. As this company is licensed to manufacture electrical apparatus and supplies under all the patents owned and controlled by the American Bell Telephone Co., and actually produces upward of 50,000 new telephones yearly, the magnitude of the work of testing is very great. Large numbers of telephones are sent abroad, as nearly all the telephonic apparatus used in Belgium, Holland, Norway, Sweden, Russia, and Italy is made in this country.

Very interesting and expensive experiments are often undertaken by the company. Among these may be mentioned experiments in long-distance telephoning. A very heavy copper metallic-circuit line, nearly 300 miles long, has been erected between New York and Boston, and conversation is carried on between those cities with perfect ease, much more satisfactorily, in truth, than over most of the local city circuits. Plans are now being perfected for overcoming certain difficulties in connecting local subscribers to this trunk line, in order to insure satisfactory service and secure commercial success. This line will undoubtedly be soon in the hands of the local company, and open for public use. The results thus far attained point to a speedy solution of the long-line problem; and in a few months the wonder will be why long-distance telephoning was not sooner introduced.

In order to meet as far as possible the public demand for underground wires, the company has been and is now making extended experiments upon various makes of subterranean cables, with as yet only partial success. To give an idea of the vast sums of money the company is expending in this experimental work, it is only necessary to state as a single example that one of these cable experiments cost $30,000, and that this is by no means the maximum outlay for a single experiment.

Of the future possibilities of the telephone little can with safety be said. Recently an invention has been brought out for making the telephone an accurate timekeeper. By means of a simple apparatus, including an accurate clock stationed at the central office, a signal is given once a minute indicating the precise time, somewhat after the manner of a repeater watch. This system is now on trial at Lowell, Mass., and seems likely to be generally introduced.

The Bell telephone exhibit at the Electrical Exhibition now in progress at Philadelphia is well worth the careful attention of visitors. It forms one of the most prominent features of the exhibition. The whole history of the telephone from its first conception to the present complex system is well illustrated by models, some of the original apparatus being on exhibition. Many forms of apparatus now discarded from use are shown; and all the latest improvements, including the most recent style of multiple switchboard, may be seen.

The International Electrical Exposition.

(SECOND PAPER.)

The exhibitors, at first somewhat dilatory, have now for the most part got their apparatus in working order; a score of fly-wheels spin and impart their regular movement to innumerable and curiously contrived apparatus throughout the well ordered corridors. A careful examination of the collection shows that the boast of the managers that they would have the finest workmanship known in the electrical field was not vain, and sustains the assertion made in these columns that the collection was to be commended for its completeness rather than for the novelty of its exhibits. In reality, the exposition now being held in Philadelphia is international in little else but the name, for only a tithe of the exhibits come from beyond seas.

Indeed, it may be said, without the fear of contradiction, that of the 2,000 exhibits, fully four-fifths come from New York. But the spirit that animates this enterprise is Philadelphian, and the ability shown in organizing the various departments, by the committee of the Franklin Institute having the conduct of the exposition, and the good judgment and fairness evidenced by its decisions, do much to prove that the handiwork of American electricians could not have been intrusted to better hands nor shown under more favorable conditions.

In the arc light section a new lamp has appeared which, when properly displayed, is likely to attract no little attention among those engaged in street illumination. It is called the Edgerton thorough feed arc lamp, and is designed to greatly reduce the cost of arc lighting. If the projectors of this lamp do not deceive themselves, it is, perhaps, among the possibilities of the future that a profit will be found in selling the arc-light approaching that in selling the plant.

The Edgerton arc-light consists of a framework of cast iron supporting the tube for feeding the carbon and the other operative parts of the lamp. The body or base of the lamp contains the electro-magnets for feeding the carbon and also supports a horse-shoe shaped frame for supporting the globe. The peculiarities of the lamp are: First: The substitution of an indestructible point of iridium set in a wrought iron rod properly protected from oxidation, for the negative carbon electrode of the lamp. This saves the use of one carbon. Second: It is thorough fed; for all the carbon of the positive electrode is consumed; the latter end of each carbon becoming attached to the carbon, which follows it in course so as to form practically a single stick. Third: It will turn and feed in any position in consequence of the carbon being carried forward by two grooved rollers under strong pressure. Fourth: Owing to the construction and operation of the feeding mechanism, it cannot close or extinguish the arc during the full flow of the current. The operation of the lamp may thus be stated: The carbon being placed in position, its forward end in contact with the iridium point, and the currents being switched into the main magnets immediately upon the arc to say one thirty-second of an inch, and the armature coming in contact with the poles of the magnet remain fixed in that position.

The small magnets in the shunt circuit then come into play, and, as soon as the arc has turned to one-sixteenth of an inch, or whatever length has been set for it, the armature is lifted, turning the rollers and carrying the carbon point forward to the first position. It continues to repeat this action until the current is cut off.

The question of burying the wires is one which, of late, has attracted considerable attention in America. In New York, Brooklyn, Philadelphia, and other large cities, ordinances have been passed requiring that all overhead wires shall be buried, and fixing a date beyond which their owners may not maintain them above ground. It is not surprising, therefore, that there should be a large display of underground apparatus and conduits at the present Exposition, nor is it remarkable that, since many reliable electricians have declared the plan to bury all the wires of a great city to be impracticable; most of these underground exhibits should bear upon their faces the unmistakable evidences of failure. In the last number of the SCIENTIFIC AMERICAN was described one of the most promising of these underground systems. Another and perhaps still more promising system may be said to be constructed upon a theory the reverse of that adopted by the underground cable people. In other words, the constructors of this underground system have sought to accomplish with a conduit what the cable people may be said, without injustice, to have thus far failed to do, or rather to demonstrate their ability to do. They claim that they can keep out all moisture and protect the boxed-up wires from surrounding mal-influences by means of the interjection of dry air. How well they have succeeded it is not the purpose of this article to decide. It will simply be sought to describe the apparatus which, since altogether novel, merits some little attention. The general appearance of the conduit is that of a deep trough, having rails for a miniature electric motor. There is an upright upon this motor, furnished with arms bearing hooks. When it is necessary to introduce a wire, the motor is started from the manhole at the intersection of the streets through which the conduit has been laid. At the opposite manhole—one block distant—a lineman receives the end of the wire from the motor, and shakes it off the hook into whatever apartment it is designed for. Connections to houses from the conduit may be made by an adjunct running under the sidewalk. The walls of the conduit are made of blocks composed of asphalt compounded by a new process, whereby it is said to be rendered impervious to moisture and to be given unusual strength. The metal uprights, brackets, and pockets are connected with the earth so as to ground induced electric currents. This construction is said to be much cheaper than iron, and not so apt to become electrically charged. When wires are laid parallel and currents of electricity passed over them, every make, break, or change in tension in the electrical current in one or more of the wires will produce induced currents in neighboring wires, the currents being inversely proportional to the distance of the wires apart. With telegraphy these induced currents are of little consequence, but with telephony the converse is the case, for with the small electromotive force required in the telephonic system, their effects are felt at once and necessitate the application of means to overcome these malign influences, which otherwise would so injure the transmission of articulate speech as to render the burying of telephonic wires impracticable. The sheet-iron pockets being good conductors and magnetic, tend to carry off the induced currents. The metal uprights supporting the curved pockets are grounded at proper intervals along the line to assist in conveying the induced currents to earth. A portion of an anti-induction cable is shown in the underground exhibit at the Exposition, which is said to be adapted to underground purposes. It consists of weaving together insulated telephonic wires, forming what might be called the "warp"; bare inclosing wires forming the "weft." The latter are grounded through the agency of the pockets and conduit auxiliary ground wires.

The difficulties of dealing with currents of high electromotive force are well known. Damp weather or even the moisture of an underground conduit allows the escape of the current to a lesser or greater degree, and thus reduces its tension. This has heretofore rendered the burying of such wires impracticable.

The projectors of this system claim that in their conduit the tension of the current is retained at its maximum; there being no dampness to affect the tension. Their conduit is incased in brick, and is so constructed, they say, that they can keep the air within under considerable pressure and perfectly dry. If there be an appreciable quantity of moisture in the atmosphere, an air pump is made to force the air in the conduit through a drier, which absorbs the moisture, and chemically dried air is made to pass into the conduit. When the pressure reaches a certain figure, the excess of air is excluded through relief valves. Currents of high tension tend to pass off the conductors, but this tendency decreases as the pressure of the surrounding medium (air) increases. This effect, it is said, is greatly increased by the thorough drying of the air in damp weather before passing into the conduit.

As the pressure is constant, there must be an efflux, and should there be a small leak the passage of air will be from inside outward ; thus preventing the ingress of the interior atmosphere.

The silicious bronze wires in the manufacturing exhibits demand, by reason of the important part they are likely to play in the future, more than a passing notice. In this era of great enterprises, where economic processes are continually sought after, that which combines a maximum efficiency with a minimum of labor is looked upon as the most desirable. Now, recent experience has shown that silicious bronze wire is about twenty-five per cent. cheaper than iron wire, everything considered, besides having nearly double the conductibility. So far as tensile strength per square inch of section is concerned, iron wire has no advantage. Perhaps this might be better explained by saying that the far greater weight of the iron wire costs more to handle, requires more and stronger supports and insulators, nearly twice as many posts, and more than twice as many couplings than silicious bronze. The subjoined tables, compiled by an authority, give the electrical resistances and approximate weights per mile of silicious bronze.

TELEPHONE WIRES.

Diameter.	Section.	Resistance in ohms per mile.	Weight per mile.
Mm.	Sq. mm.		Lb.
1	0·7854	103	24·6
1·05	0·8655	93	27·1
1·10	0·9503	92	30·0
1·15	1·0383	77	32·5
1·20	1·1310	71	35·6
1·25	1·2252	64	38·5
1·30	1·3273	61	41·6
1·35	1·4294	56	44·8
1·40	1·5393	51	48·3

TELEGRAPH WIRES.

1·25	1·22	22·5	38·5
1·50	1·7671	15·6	55·6
2·00	3 1416	8·8	99·2
2·25	4·4741	6·2	141
2 50	4·9087	5·6	156
2·75	5·938	4·6	187
3·00	7 0685	3·9	223
3·50	9·6211	2·8	303
4 00	12·5664	2·4	296
4·50	15·9043	1·8	502
5·00	19·6349	1·4	620

Now let us compare this silicious bronze wire with iron, steel, and copper wires, taking one millimeter as the diameter in each case.

Description of wire.	Tensile strength per sq. in. in tons.	Resistance per mile in ohms.	Relative conductivity.
Pure copper	17·78	33·1	100
Silicious bronze telegraph	28·57	34·5	96
Silicious telephone	48·25	103	34
Phosphor-bronze telephone	45·71	124	26
Swedish galvanized iron	22·86	216	16
Galvanized Bessemer steel	25·40	249	13

The galvanized wire of five millimeters diameter, now in general use, weighs about 540 pounds to the mile. It could be replaced by wires of silicious bronze, having a diameter of only two millimeters and weighing about a hundred pounds to the mile. Silicious bronze wire of 1·10 millimeters and weighing 29 pounds to the mile can readily be made to do the work of ordinary steel telephone wires of two millimeters diameter and weighing 87 pounds to the mile.

Among the exhibits of the Ordnance Department, or rather of its auxiliary, the Signal Service, is a field telegraph train by which telegraphic communication may be kept up between the several portions of an army or between scattered bodies of troops. This is an exceedingly important branch of the Ordnance Department in these days, and it must be said that those who designed the present system have acquitted themselves well. It is modeled after the French system, or rather it has many points in common with it, divested, be it said, of the elaborate and cumbersome details of the system employed in the French army, which, as was clearly demonstrated in the maneuvers of four *corps d'armee* last fall, can only be carried out under the most favorable conditions. The system exhibited by Captain Michaelis in the present Exposition has this to commend it, and may therefore be more than favorably contrasted with the French. It is designed for use as well under unfavorable conditions, viz., when time presses and in rough country, as when time is of no moment and a large body of trained men are at hand to carry out details. If it have a serious defect, it is that the line is too heavy for the service; the French linesman furnished with light silicious bronze wire being able to traverse a much longer distance, and the mass on the bobbins being very much less.

In measuring the velocity of projectiles, it is easily seen that our Ordnance Department is by no means behind the age; several new and interesting features having been recently introduced. A long tube has two delicate diaphragms within. These are electrically connected with a disk whereon the moment of their disturbance is recorded. As the projectile passes through, the two contacts are instantaneously signaled.

The instrument devised by Captain Le Boulenge of the Belgian artillery has given excellent results, one or two not important changes having recently been made by him. It can be used both as a micro-chronometer and as a velocimeter. Two electric circuits are established within a tube through which a projectile is fired.

When the first circuit is reached, it affects an electro-magnet having for armature a cylindrical rod acting as a chronometer, to which are attached two enveloping zinc tubes as recorders. When the second target in the tube is reached, it sends a current through an electro-magnet, the armature of which, shorter than the first described, is called the register. Then there is what is called an indenter; consisting of a circular knife fixed in a mainspring. This is readily primed by means of a catch on a lever. Now when the first circuit is reached the chronometer is made to fall, and upon the breaking of the second circuit the register also falls. This depresses the end of the lever, the mainspring is released, and the knife springs at the falling chronometer and leaves an indentation on the recorder. So simple is this instrument that only a short calculation is necessary in order to find the velocity of the projectile. The recorder is marked highest when the velocity is lowest. Of course it is necessary that the operator thoroughly understands the theory upon which the instrument is constructed, for certain allowances must, perforce, be made, for instance for the time required for the demagnetization of the chronometer and the register before the fall takes place. In advance of operations it is, of course, necessary to test the instrument; a disjunctor being used to examine both circuits.

The Schultz chronoscope, invented by Capt. Schultz of the French artillery, designed for measuring very short intervals of time, and the electro-ballistic pendulum, are also to be seen in the exhibit.

There is a very interesting exhibit in the theoretical department of the Exposition, on thermo-electricity. There are those who affirm that these machines will at some future day supplant the dynamo, as the dynamo has supplanted the galvanic battery. This thermo-electrical machine is made up of a system of plates composed of alloys of antimony and bismuth soldered together and properly joined in the usual way, the joints being heated by Bunsen burners.

A very interesting apparatus for safety from lightning is shown by a telephone company. It is designed to be placed outside of a building, and contains a lightning arrester and fusible wire, and a cut-out switch operated from the inside. By this the electric current can be wholly disconnected from the interior. The telephone subscriber upon leaving his office can entirely disconnect the instrument until his return, and old ladies who show a disposition to be timid as to lightning when thunder clouds prevail, may find in this a convenient means of arresting the lightning and their fears.

A curious feature of the Exposition is the important part taken therein by gas, in one form or another. It might fairly be claimed for the gas-motor that it is part of an electric-lighting plant. It would, however, be a refinement of sarcasm to setup such a claim for the gaslamp. But the gas lamp is there; not the little, flickering jet, combined, by reason of a clogged aperture, into one long, thin prong of flame, but represented in all the grandeur of a Siemens regenerative gas burner—intense and mellow. The admission of this lamp would seem to be but a simple act of justice, and as such does credit to the wisdom of those having the conduct of the Exposition, for, though it cannot from any point of view be classed under the head of electrical appliances or apparatus, it represents a system of lighting which the electric light is designed to supplant, and unbiased decision can only be reached by a comparison of the two systems side by side.

It must be said that the big gas lamp cuts a good figure, notwithstanding that the arc lamp—for, of course, there is no comparison between it and the small incandescent—is displayed under the most advantageous conditions. By this it is meant that the arc lamp, when standing alone, brilliantly illuminates certain portions of the space about it, and leaves other portions in deep shadow, while as it is displayed at the present Exposition the shadows are cut out by the glare of the adjacent lamps. It is only just to say this much; only simple justice to say that the arc lights are shown under favorable conditions, and that the big Siemens regenerative burners are shown under ordinary conditions; their light when isolated being evenly diffused, while the converse is the case with the arc light.

Subjoined is a table giving the consumption of gas per hour and the candle power of the gas burners at the Exposition:

Gas Consumption per hour.	Candle power.
100 cubic feet.	1,000 to 1,200
75 "	750 " 900
50 "	450 " 500
35 "	300 " 350
25 "	200 " 250
14 "	100 " 125
8 "	70 " 80

This, even if not an underestimate, shows that these lamps, with gas at $2.25 a thousand cubic feet, are fully as expensive as the arc lights, if the figures at which they are rented are reliable.

So far as the incandescent lights are concerned, they are holding their own, as it was known they would. On the hottest evenings they have neither vitiated the atmosphere nor sensibly heated it, whereas, were these hundreds of lights, now aglow, given off by gas, it is safe to say that the atmosphere of the great hall would be intolerable.

Correspondence.

Filtration of Oil.

To the Editor of the Scientific American :

One of your correspondents some time ago wished to know if there was any way to clean sperm oil so as to use it over again. I expected some one would give an answer, so I have waited to see what it would be; but seeing none, I take the liberty to state that I took a common wash boiler, had a faucet put in the bottom, and soldered on tin lugs about half way down inside, made a wooden frame that would go inside and rest on to the lugs. I tacked on to this frame for the bottom four thicknesses of coarse bagging; on to that I spread loose four thicknesses of cheese cloth, then sprinkled over the cloth coarse soft wood sawdust, then four thicknesses of cheese cloth, then sawdust again, for three successive times, with four thicknesses of cheese cloth on the top. I pour the oil into this frame within the boiler, and it will filter all the dirt out. It will become colored by constant use and filtering, but it will be free from dirt. I found by using this filter I have made ten gallons of sperm oil do the lubrication that would have taken thirty gallons. I think that is worth saving. Cheap filter, but it does the work.

GEO. BOXLEY.

Troy, N. Y., September, 1884.

Lifting of Persons by the Fingers.

To the Editor of the Scientific American :

Your answer to T. G. L. (No. 15), in the SCIENTIFIC AMERICAN of August 23, indicates that you have never tried the experiment referred to. I have in this manner:

Two persons stand on each side of a fifth, who is seated in a chair. The four raise their hands (which are clasped with the forefingers extended) as high as possible over their heads, at the same time inhaling deeply. They then simultaneously bow as low as possible (always facing the sitter), bending the body from the hips, and swinging the extended arms from the shoulder till the hands touch the knees, at the same time exhaling as strongly as possible, these motions being repeated three times together. As they rise from the last position for the third time, the extended forefingers are placed under the knees and arms of the sitter, and he is lifted high in air as light as a feather. In this way I have seen four young school girls, under sixteen years, lift a man of 180 pounds with no more apparent exertion than would be required to lift a three pound weight. To one who tries this experiment for the first time the result is very surprising.

"HAMLET."

Washington, D. C., Sept. 3, 1884.

The Liquefaction of Air.

M. Olzewski has contributed to the *Comptes Rendus* some of his further observations upon the temperature and critical pressure of air. He says he has obtained 6 cubic centimeters of air compressed into the liquid form. This air did not contain carbonic acid or aqueous vapor, and was allowed to evaporate in a vacuum, and also under atmospheric pressure. A very low temperature was thus produced, as low as —205° C., being observed when the evaporation took place *in vacuo*. It appeared, however, that the recorded temperature of the liquid air at the critical point was not so low as that of its constituents, oxygen and nitrogen, separately. Consequently, M. Olzewski was led to think that at the critical pressure the components separated; nitrogen evaporating in the larger proportion. Therefore, although air is a very convenient refrigerant, for various practical reasons M. Olzewski is disposed to prefer the use of nitrogen in his researches upon the liquefaction of hydrogen, as he thereby hopes to be able to command temperatures even lower than that given as the evaporation point of air in a vacuum.

Cost of Bread in Boston and New York.

Mr. Atkinson shows us that the farmer in Iowa receives $405 for the wheat to make 100 barrels of flour, and that the railroad then receives $117.50 for taking 450 bushels of wheat from Iowa to Chicago, and 100 barrels of flour from Chicago to Boston. Upon this the railways make about $35 profit. It costs $50 to mill the flour, $45 for barrels, $30 for the merchant's commission and the cartage in Boston, $410 for the labor of making 100 barrels of flour into bread, for fuel with which to bake it, yeast, salt, etc., costing only $1,057.50 from the farmer on to the baker's counter for 100 barrels of flour made into bread, 270 to 290 pounds per barrel, or about 3½ cents per pound, while the people of Boston pay $1,620, or about six cents per pound, against 3½ cents in New York.

Economy of Expense of Management in Life Insurance.

The current issue of the SCIENTIFIC AMERICAN SUPPLEMENT contains a very able article on this subject, written by Walter C. Wright, Actuary of the New England Mutual Life Insurance Company. The article will repay careful perusal, and the tabular statement which accompanies it will be found of much value to any one interested in life insurance, as it shows both the expense per $100 of claims paid and the net rate of interest earned. These figures are taken from the official reports of the various companies, and furnish conclusive proof as to which of the companies are the best and safest.