sounds. This has been brought about by mechanically tuning the disc D and the reed P of the telephone relay to the corresponding low note, and by a proper proportioning of the volume of air enclosed by the tube B. On other occasions, during private experiments, the instrument has been tuned so that nothing but the breathing sounds were audible; the passage of air through the lungs was heard as the roar of the wind through a forest of trees. This power of discrimination should be of service in allowing the independent examination of various organs of the body.

Replacing the telephone head-piece by a transformer, the stethoscope has been joined to the telephone service in my house, and, for the sake of experiment, the sound of the heart has been transmitted over several miles of telephone line to doctors in various parts of London and to other friends who were interested. All of them reported that the sounds received in the telephone were as loud and clear as when heard locally. The line, therefore, does not appear to produce much loss or distortion. This trial proved that it is now possible for a specialist, say, in London, to examine a patient, say, in the country, stethoscopically, and to arrive at a correct diagnosis.

The instrument must of necessity, to replace the ordinary stethoscope, be more sensitive to sound than the human ear. This is proved by slight noises made in the room being heard in the telephones as loud noises. In consequence of this, the apparatus is padded and guarded, so far as is possible, from all outside disturbances, and the patient should be examined in a quiet room. If the instrument is provided with a small funnel in place of the tube B, it will pick up and magnify the slightest sound, and ordinary speaking may be increased to a deafening shout in the telephone. Such an instrument, when properly constructed for the purpose, may be of use to those who are afflicted with deafness.

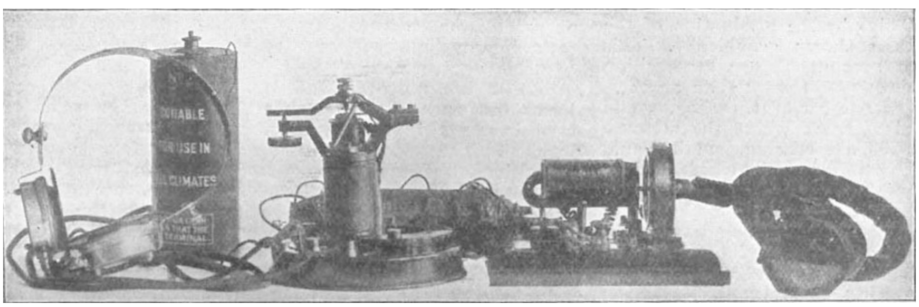

Fig. 8.—Electrical Stethoscope and Telephone Relay ready for use.

The relay has been used on the electrophone system, and by its aid, damping the reed with a piece of rubber, the speaking and music from the theatres are rendered with loudness and greater clearness than it is possible to have on the telephones supplied by the company, and by adding a loud speaker with trumpet the sounds can be heard in the room.

THE IRON AND STEEL INSTITUTE.

The annual general meeting of the Iron and Steel Institute was held on Wednesday and Thursday, May 4 and 5, at the Institution of Civil Engineers. The retiring president—Sir Hugh Bell—inducted the president-elect, His Grace the Duke of Devonshire. After presentation of the Bessemer medal to Mr. E. H. Saniter, of Rotherham, for scientific services rendered to the iron and steel industry, the Duke of Devonshire gave his presidential address. In the course of a long and detailed account of the rise and progress of the coal, iron, and steel industries in this and foreign countries, the president also reviewed the social and economic conditions over the period from 1869, when the institute was founded under the presidency of the seventh Duke of Devonshire, to the present time. Conditions of work are now safer and more sanitary; wages are better, and working hours lighter. Housing is better, and a host of improvements in traffic, lighting, education, and public assistance have made for the comfort, health, and enlightenment of the people. Taking increase in wages paid to the worker, and also the increased spending power of these wages, into account, His Grace quoted statistics showing a net increase, for the period mentioned, of 90 per cent.

The meeting then proceeded with the reading and discussion of papers, thirteen of which were presented. Owing to lack of time, several of these had to be taken as read. In the case of those actually presented at the meeting, the time allowed to the author for explaining the contents of his paper was in each case ten minutes. The institute is to be congratulated on the high standard and importance of the papers presented, but we think that it will be difficult to maintain this standard unless in future more time is placed at the disposal of the authors at the meetings.

Mr. D. Selby Bigge, in a paper on the development in the production of electric power, pointed out that considerable progress had been made in the cost at which electricity can now be produced in iron and steel works having at their disposal waste gas, waste heat, and waste steam. One of the means by which low cost of production has been attained is the mixed pressure steam turbine. Such turbines differ from exhaust steam turbines in that the latter are intended to derive their supply of steam from engines which run continuously, such as blowing engines and pumping engines. Mixed flow turbines may work with reciprocating engines which are only in action intermittently. A continuous supply of steam is obtained for the turbine by adopting a form of regenerative accumulator, the action of which is as follows. The exhaust steam is taken from the engines and mixed with water, both coming to the same temperature. Supposing, now, a drop in pressure of 1½ to 2 lb. per square inch to take place in the accumulator, owing to the exhaust steam supply being cut off, the water in the accumulator at once gives off vapour, thus keeping up the supply to the turbine. Any sudden rushes of exhaust steam from the engine are utilised in storing heat in the accumulator, and will be drawn on for supplying the turbine during the next pause in the supply of exhaust steam.

The turbine is built in stages, one set being designed for the working pressure of the existing boilers, and so constructed as to give off the full output of the turbine upon live steam when required; the other set is designed for the utilisation of exhaust or low-pressure steam received from the accumulator in the case of engines working intermittently, or direct from the exhaust of engines running continuously. The low-pressure end of the turbine is also designed to give out the full rating or output upon low-pressure steam alone. Should the full supply of exhaust steam fail from any cause, live steam is automatically admitted to make up the temporary deficiency in the exhaust steam available. Further, high-pressure steam is admitted when required to the high-pressure stage without the intervention of a reducing valve. To secure efficiency, a high vacuum must be secured, and the selection of a suitable condenser must be carefully considered. Various types of turbines, gas engines, and electrical installations for steel works are described by the author in the paper. The adoption of any particular system must obviously depend on the circumstances; each case must be considered on its merits. It is of interest to note that the Duke of Devonshire in his address cited the economy effected last year at the Barrow Works, where the installation of eight gas engines to replace the steam-driven engines produced an immediate saving of 1500 tons of coal weekly.

An interesting paper on the cutting properties of tool steel was contributed by Mr. Edward G. Herbert, of Manchester. It is well known that a high-speed steel tool with

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a light cut and a high speed will keep its sharp edge better than a carbon-steel tool. The durability of all steels, without exception, is very low at low speeds under light cuts, and increases as the speed is raised, the durability being measured by the amount of metal cut away before the tool becomes blunt. The engineer usually requires the steel that will remove the greatest amount of metal per hour without requiring too frequent sharpening, and it is useful to express the "duty" of a tool steel by the product of metal removed and corresponding cutting speed, thus obtaining a quantity which is proportional to the time rate of removing metal and to the durability of the tool.

To account for the fact that an increase in the cutting speed is accompanied by an increase in the durability of the tool, it has been suggested that the evolution of heat, and consequent rise in temperature of the cutting edge, may be the influencing factor, and experiments are described in the paper giving confirmation of this view. In these experiments heat was applied artificially to the tool while cutting by means of hot water, and tests were made at different temperatures. A law has been deduced from the results which may be stated thus: for constant durability of the cutting tool the speed varies as the cube root of the product of area of cut by thickness of shaving. Experiments were also made on the effects of temper and of the percentage of carbon on the durability of carbon steel, and on the effect of the cooling process in the case of high-speed steels.

Prof. J. O. Arnold, in his paper on uniform nomenclature of iron and steel, earnestly pleads with metallographists strongly to support Prof. le Chatelier in his effort to abolish personal names for the constituents of steel. Mr. Sydney A. Grayson, of Birmingham, gives the results of some recent investigations on case-hardening, from which it appears that it is necessary to classify case-hardening compositions both by the carbon per cent. obtained in the "case," and also by the graduation of the carbon diffusion, which is best shown graphically. This classification is necessary on account of one composition being more suitable for certain kinds of work than another. A high carbon "case," such as 1·10 per cent. carbon, would be very efficient for the kind of work where the pressure was fairly constant, such as a plain bearing, but it would be very unsuitable and inefficient for parts which had to resist repeated shocks, because of the strong tendency of the high carbon "case" to chip, or even to peel off. It is advisable, where all kinds of case-hardening have to be done, that two compositions be used, one of them to produce a high carbon wearing surface, and the other to produce a medium carbon wearing surface.

Mr. C. A. M. Smith, of East London College, adds to his previous work on the elastic breakdown of certain steels an investigation of the possibility of non-axial loading occurring in test-pieces held in the testing machine on spherical seats, and shows that, in the case of a 50-ton machine in which the radius of the seats is $1\frac{1}{2}$ inches, the eccentricity may amount to 0·15 inch, with a coefficient of friction of 0·1. The ratio of maximum to mean stress would then be at least 2·2, and in one test where eccentricity was known to exist, a ratio of 2·96 was found.

A GEOLOGICAL SURVEY OF COLORADO.[1]

THE State of Colorado is one of the most famous in the history of American mining, but though its Geological Survey was created in 1872, and has included on its staff some distinguished men, it has done comparatively little, for it remained practically without funds until 1908. The Survey has now been provided with an annual subsidy and a staff, Mr. R. D. George being State geologist with sixteen assistants. Its first annual report has been issued, and shows that the Survey has been organised on sound lines, for it contemplates cooperation with the Federal Survey and private local geologists, and the advancement of local education by presenting a collection to illustrate the mineral wealth of Colorado to every high school in the State.

The first volume consists of five valuable memoirs upon the geology of Colorado, illustrated by geological and topographical maps. The stratigraphical geology of the foothills is described in a memoir by Mr. J. Henderson. They consist of a foundation of Archean and Algonkian rocks, which are covered by a long succession of sediments, representing continuous deposition from the Carboniferous to the Laramie, at the end of the Cretaceous. This succession consists of 10,000 feet of strata, partly marine and partly terrestrial, and apparently all conformable. The beds were laid down in the course of a slow subsidence of the country, so that the higher members of the series overlap one another on to the older rocks to the west. After the Laramie there was a break, and the chief Cainozoic deposits are of Miocene age.

The other memoirs deal with economic geology. Each is well arranged, and accompanied by a useful bibliography. Mr. R. D. George and Mr. R. D. Crawford contribute an outline survey of the Hahns Peak mining field, thirty miles from the railway terminus at Steamboat Springs. Hahns Peak itself is a porphyry laccolite, once covered by Cretaceous rocks. The goldfield is one of those interesting cases in which no certain source has been discovered of the gold in rich placer deposits. The lode mines hitherto found yield silver-lead ores, and their working has not been remunerative. The popular local belief as to the source of the gold is that it has come from the porphyrites, of which the junction with the sediments is generally mineralised; but it has also been attributed to conglomerates at the base of the Dakota formation and to pre-Cambrian metamorphic rocks.

Mr. George contributes a valuable memoir on the tungsten area of Boulder County, accompanied by notes on the intrusive rocks by Mr. R. D. Crawford. It includes a brief account of the tungsten deposits throughout the world, and of the technical uses of the metal. The Boulder tungsten field consists of gneiss of sedimentary origin, which is seamed by dykes of pegmatite, which the author claims, in this instance, to be an intrusive rock and not a pneumatolytic product. There are also dykes of latite, a rock intermediate between trachyte and andesite. The tungsten ores are mostly found in the granite; the veins in gneiss are narrower and less profitable, as that rock forms less open channels when disrupted. The veins are very irregular in arrangement, but are generally steeply inclined. The tungsten was introduced by four successive depositions. There has apparently been considerable difficulty in the concentration of the ore, owing to its extreme friability, and the author suggests the use of magnetic methods, which have proved successful in Cornwall. This report is illustrated by a series of plates of which six are especially useful, as they show the various types of ores.

The last report is by Mr. H. B. Patton, on the Montezuma district of Summit Country. The rocks of this mining field are the Archean schists and gneiss of the Front Range, injected by acid and diabase dykes. The ores are replacement veins composed of quartz containing lead, zinc, and a little copper and some silver and gold. Unlike some Colorado mining fields, descending water appears to have had very slight effect upon the ores, and there has been little secondary sulphide concentration. The porphyritic dykes are of Cretaceous date, and the ores were introduced later than the formation of any rock in the district. The distribution of the ores appears to be quite independent alike of the dykes, pegmatite veins, and cleavage. The ore bodies lie along joint planes, on which there may have been some movement by strike faults. There is, however, no direct evidence that the ores were connected with faulting, for the cross-faults are barren, and the joint planes may have been mineralised simply because they were planes of weakness, which offered the ore-bearing solutions the readiest channel to the surface.

J. W. G.

[1] Colorado Geological Survey. First Report, 1908. By R. D. George. Pp. v+243; 22 plates, 4 maps. (Denver. 1909.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Mr. C. L. Boulenger, of King's College, Cambridge, has been appointed to the lectureship in zoology rendered vacant by the resignation of Mr. Leonard Doncaster.

Dr. Leonard Parsons has been appointed assistant lecturer in pathology and bacteriology to succeed Dr. Leonard Mackey.

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