Abstracts of Bell System Technical Papers Not Appearing in this Journal

A Photo-electric Process of Halftone Negative Making Applicable over Telephone Lines.[1] H. E. IVES. The commercial process of making halftone engravings breaks the picture up into a large number of dots by means of a screen. Unless special intermediate processes are adopted this does not reproduce the tones correctly because the size of the dots is not directly proportional to the light intensity. This paper describes an adaptation of the photo-electric system of picture transmission, as an alternative for use of screen, which produces individual dots more accurately proportional in size to the light intensity.

The method proposed thus affords a means of improving quality in halftone engraving by using an outfit similar to the picture transmitting and receiving outfit. Used in connection with the commercial picture transmission service, it can provide pictures with an accurate tone structure during the transmission process so that the resulting copy is ready for the engraver without the use of any screen process. Full details of several arrangements of the apparatus are given together with engravings produced by the photo-electric method.

The picture transmission system as used transmits the picture in the form of a continuous strip of varying intensity. By the introduction of a synchronized sectored disc this strip is made discontinuous, forming the dots for the halftone process.

Advance Planning of the Telephone Toll Plant.[2] J. N. CHAMBERLAIN. A general review of the commercial studies which precede the design of telephone toll plant is given together with some specific data concerning the toll line conditions in the northern California area of the Pacific Telephone and Telegraph Company. Attention is called to the special conditions requiring a large amount of submarine cable plant resulting from the peninsular location of San Francisco. The Pacific Company has plans for about 1,000 miles of toll cable network in its present program which it expects to install at the rate of 100 miles a year. The article places special emphasis on the commercial factors governing the choice between cable and open wire construction for future extensions of the toll plant.

[1] *Opt. Soc. Amer. Jl.*, Vol. 15, p. 96, August, 1927.
[2] *Jl. Am. Inst. El. Engrs.*, Vol. 46, p. 994, October, 1927.

The Adsorption of Gases by Solids with Special Reference to the Adsorption of Carbon Dioxide.[3]   H. H. LOWRY and P. S. OLMSTEAD. This paper presents a theory of adsorption and its mathematical development, which is similar to but differs somewhat from that of Polanyi. A detailed description is included of a relatively convenient method of application of the theory to experimental data. Using this procedure, a test of the theory has been made on the data obtained by Homfray, Titoff, Richardson, Chappuis and S. O. Morgan for the adsorption of carbon dioxide by charcoal. The very satisfactory agreement obtained between experiment and theory gives support to the fundamental assumptions underlying the theory.

The Densities of Coexisting Liquid and Gaseous Carbon Dioxide and the Solubility of Water in Liquid Carbon Dioxide.[4]   H. H. LOWRY and W. R. ERICKSON. The densities of coexistent liquid and gaseous carbon dioxide are measured over the temperature range − 5.8 to 22.9° and it is shown that they can be satisfactorily represented by equations involving the first and one third powers of the temperature on the critical scale. The data are shown to be in substantial agreement with those of other observers. It is also shown that the density of saturated carbon dioxide vapor is the same within the experimental error in the presence or absence of water, from which it is concluded that the solubility of water in liquid carbon dioxide is less than about 0.005 per cent by weight over the temperature range of the investigation. Attention is called to qualitative evidence of the formation of a solid hydrate of carbon dioxide at about 4°.

Atomic Grouping in Permalloy.[5]   L. W. McKEEHAN. This is a theoretical paper which follows a long series of experimental papers. In a solid solution of two metals, e.g., in the solid solution of nickel and iron known as permalloy, the atoms of both kinds occupy in each crystal the points of a single space-lattice. It is important to know whether the points so occupied by atoms of a single kind are located at random or have some regularity of arrangement. If the latter is the case, it may be asked further whether the regularity is due to the frequent occurrence of definite groupings of unlike atoms or merely to a tendency for atoms of one kind to separate from each other as widely as possible. The magnetic properties of permalloy are here taken to show that the last-mentioned possibility is probably nearest

[3] *Journal of Physical Chemistry*, Vol. 31, pp. 1601–1626, November, 1927.
[4] *Journal of the American Chemical Society*, Vol. 49, pp. 2729–2734, November, 1927.
[5] *Jl. Franklin Inst.*, 204, 501–524 (1927).

to the truth.   The method is a combination of analytical and graphical analysis applied to several hypothetical solid solution crystals each containing more than a thousand atoms.   It may also, as is pointed out in the paper, be used in problems concerning other than magnetic properties of solid solutions.

The Short Wave Limit of Vacuum Tube Oscillators.[6]   C. R. ENGLUND. A study of the shortest attainable undamped waves which can be produced with vacuum tube oscillators resulted in the production of one-meter waves as the fundamental mode of oscillation of the circuit. The shortest waves "attainable with reasonable ease" with several types of standard tube are found to be:

Tube	Meters
W. E. 230-D (60 mil. fil.)	2.0
" 205-D ("E" 5-watt)	3.2
" 221-D (1/4 amp. fil.)	3.3
" 211-D ("G" 5-watt)	3.5

In order to reduce the capacity as far as possible some experiments were made with unbased tubes.   A special 5-watt tube produced four-meter signals which were received up to one-mile distances.   An interesting feature of the work was the interference caused by the presence of the observer while conducting the experiments, because of the action of the human body as a tuned antenna at these wave-lengths.

A General Theory of the Correlation of Time Series of Statistics.[7] M. K. ZINN.   In mathematical physics elaborate methods have been devised for dealing with oscillatory systems, damped or undamped, like pendulums, vibrating strings, vibrating telephone diaphragms, and with systems that are essentially damped but have no oscillatory characteristics, like the flow of heat and diffusion.   The writer of this article approaches the problem of the economic structure with a point of view which sees the business world as behaving like such an oscil-latory system.

The structure of economic society is a system exhibiting certain structural factors which express the tensions that are set up by a shift in prices here on some other factor like employment there.   The problem is: How are these tensions to be inferred from statistics which describe the observed behavior of the economic world?   The economist, unfortunately, cannot disconnect, say, the Federal Reserve system from the rest of the economic structure, connect it to a portable test

[6] *Proc. I. R. E.*, 15, 914, November, 1927.
[7] *The Review of Economic Statistics*, Harvard Economic Service, *9*, 184 (1927).

set and read off its economic impedance in the same way that an engineer can test a transformer.

He has to take instead the observed fluctuations in time of two series, say "wholesale commodity prices" and "commercial paper rates," and try to infer from such data the way in which changes in one of these quantities react on the other. The paper is concerned with the general way of doing this with a full analysis of the relation between these two economic variables from this point of view.

Just as most of the theory of oscillatory systems in mathematical physics is confined to linear systems, so the writer finds it convenient to assume linear relations between the economic variables. This greatly simplifies the mathematics. The formulas come out to be analogous to some formulas of electric circuit theory when approached from the Heaviside operational standpoint. It thus appears that much alternating current theory may come to be of value in studying economic variations. It is pleasant to think that some years hence we may be using the language of "a.c." theory (reluctance, susceptance, impedance, etc.) to describe the functional relation of one economic unit to the rest of society. Perhaps to study the relation of conditions in one part of the country to those in another we shall be using the long line transmission theory. Perhaps the theory will show us how to build economic band-pass filters which will protect us from too great fluctuations in business conditions, etc.

The application of the ideas of oscillatory systems to economics, here well started, is a subject which, it is believed, will strike a responsive chord in the heart of every electrical engineer and every mathematical physicist.

Contributions of Chemical Science to the Communications Industry.[8] CLARENCE G. STOLL. The author considers the improvements that have been made under a four-fold grouping of materials into electrically conducting, magnetic, insulating, and materials for apparatus structures. Particular emphasis is laid on the influence the chemist has exerted on the control of materials for manufacturing purposes. So many undesirable variations in manufactured products are caused by lack of uniformity in the raw materials that the aid of the chemist in standardizing testing and sampling methods cannot well be overestimated.

In conclusion, he pays homage to the readiness with which chemists have responded to demands for improvement in many of the raw materials and suggests that because of it similar demands may be of

[8] *Journ. Ind. and Engr. Chem.*, Vol. 19, p. 1132, 1927.

more frequent occurrence in the future. Among such possible innovations he mentions a better conductor of electricity, a cable covering superior to the present lead alloys, higher grade insulation, and a contact material less subject to corroding and freezing. The recent advances made in metallic alloys give every promise of a more brilliant future.

The Thickness of Spontaneously Deposited Photoelectrically Active Rubidium Films, Measured Optically.[9] H. E. IVES and A. L. JOHNSRUD. Measurements of the phase shift on reflection of polarized light from a reflecting surface on which there is deposited a very thin film of metal are described. The materials were the thin films of rubidium which are slowly deposited on glass or platinum when these have been thoroughly out-gassed. The apparatus was so arranged that measurements of the photo-electric activity could be made simultaneously with determinations of the optical effect due to the thin film. The data were then interpreted in terms of the electromagnetic theory of light using special developments due to T. C. Fry, to be published in the *Journal of the Optical Society* for January, 1928.

It is concluded from the measurements that the film of rubidium deposited on glass after fourteen days is of the order of magnitude of one atom thick. The theoretical effect of a layer of rubidium on platinum of the order of even several atoms thick is, however, so small as to lie within the errors of observation. "It thus appears, if the validity of the optical measurements of thickness is conceded, that the photo-electric emission is obtained when a layer of rubidium of approximately one atom in thickness is present," they conclude.

[9] *Opt. Soc. Amer. Jl.*, Vol. 15, 374, December, 1927.