other crops which are grown in the country, on the basis of field selection combined with self-fertilisation and hybridisation. One important and promising research which is in hand is the effect of the gradually diminishing "sharaki" (waterless) period on the soil flora. Propagation in bulk of improved strains of wheat and cotton is arranged with the State experimental farm and with selected private cultivators. The fungoid and bacterial diseases of Egyptian crops in general and of cotton in particular are investigated, and means for their control are devised and tested.

The supply of trustworthy cotton seed of the best growths is so important in order to produce a high quality of staple, and the opportunities of mixing good seed with inferior qualities before it reaches the cultivator are so many, that the Ministry actively interests itself in the matter, through the botanical laboratory.

To this may be added the important work which is being done on the flowering-curve method as an index to the effect of environmental conditions; or investigations of the causes of bud-shedding; and on the root systems of cotton plants. Similar attention is being paid to millet, rice, opium poppy, beans, and sesame; and sugar cane will be added shortly.

The Entomological Section undertakes the study and investigation of insect pests and advises on methods for their control. The fumigation of all cotton seed produced in the ginneries of Egypt is also controlled by this section, and samples of the seed obtained from ginning are sent to it for germination and examination for worms.

The work of the horticultural section should also be mentioned, for in it much work is being done in introducing and acclimatising new species or varieties of trees, and farm and garden plants.

Thus a beginning has been made to provide the scientific organisation necessary for the development of agriculture on sound lines, but something on a larger scale will be needed before it can be adequate to the country's requirements. In these institutions a number of questions of first-rate importance to the Egyptian cultivator are under study, such as the effect on the cotton crop of a high subsoil water-table, of rotation in irrigation, of reduced watering, and many others, and for their satisfactory solution the provision and efficient maintenance of a highly trained and experienced scientific staff is essential.

The scientific diagnosis and investigation of animal diseases are carried out at the veterinary pathological laboratory which was opened in 1904, and the Serum Institute, which dates from 1903, provides the anti-cattle-plague serum required for the immunisation of cattle against cattle plague both in outbreaks and as a preventive measure.

Outside the State departments science is not widely represented in Egypt. There are a few scientific societies, of which the oldest is the Institut d'Égypte, which was founded in 1859; its object is the study of all that concerns Egypt and the surrounding countries from the literary, artistic, and scientific points of view. The Geographical Society was founded in 1875 and publishes bulletins and memoirs at intervals. In 1925 the fiftieth anniversary of its foundation is to be the occasion of an international geographical conference.

The Cairo Scientific Society, founded in 1898, is an active institution which meets fortnightly throughout the winter half of the year and publishes its proceedings monthly in the *Cairo Scientific Journal.* At Alexandria a hydrobiological institute has been recently established, and much important work awaits the scientific research which should be undertaken there. But these are all too few for the needs of the country, and their paucity suggests a lack of appreciation of the importance of scientific knowledge.

In spite of difficulties due to the war, which Egypt has experienced in common with most other countries, science has of recent years been playing a more and more important part in the development of the country and its resources. The conditions there prevailing often differ widely from those which have been studied in other countries, and much research by scientific men of high training and wide experience will be necessary before the many problems which present themselves are solved. Such work is not in the interest of Egypt alone, for much that is done there will, if it is of a high scientific standard, be a permanent addition to the general stock of knowledge. Egypt in the past has benefited largely by the science and technical skill which has been gradually built up by generations of students in many lands, and she may now furnish her own quota in return by scientific research in the many fields of inquiry which the Valley of the Nile affords.

Gelatin.

By Dr. T. SLATER PRICE.

GELATIN, in the form of glue, has been so long known that, according to Dr. Bogue (*J. Franklin Inst.*, 1922, vol. 193, p. 795), "we are unable to penetrate the archives of the human race to a date where we may say with assurance that glue was not yet discovered. Certain it is that this material was in use as an adhesive in the days of the great Pharaohs of Egypt." As glue, or *κόλλα*, it has given us the term "colloid," and at the time when this term was first used by Graham it was supposed that all colloids were substances of very complex constitution, such as is glue. This, however, is by no means the case, since what are known as the suspensoid colloids may consist of the elements themselves, *e.g.* colloidal gold and silver. The emulsoid colloids, however, consist to a large extent of very complex chemical substances, as, for example, the proteins, and it is to this class that gelatin belongs. Because of its complex constitution the chemical investigation of gelatin and of the processes which occur in its extraction from bones and hides is still in its infancy, and essentially progress has only been made in the direction of the examination of the degradation products. It is therefore not to be wondered at that the enormous literature on gelatin consists, to a very great extent, of accounts of results obtained in the investigation of its colloidal properties.

Naturally, the earliest physical properties to be investigated were the viscosity of the sol and the swelling of the gel, and it was soon found that the relations were very complicated, depending on previous history, even in systems made up from gelatin and pure water alone. For example, shaking, or repeated passage through a viscometer, will decrease the viscosity of a gelatin sol; at ordinary temperatures the viscosity of a freshly made sol gradually increases, whilst that of a freshly diluted sol gradually decreases; in a freshly made gel the intensity of the Tyndall effect gradually increases; and so on, all indicative of the formation of a structure and of the attainment of an equilibrium of some kind.

If the results obtained with gelatin in pure water are so complicated it is no wonder that they are still more so in the presence of acids, bases, and salts. Von Schroeder showed that in the presence of either hydrochloric acid or sodium hydroxide a maximum viscosity of the sol is attained at a low concentration of either of these substances. Again, according to other investigators, the effect of equivalent (tenth normal) solutions of various acids on the swelling is indicated by the following series, which is known as a Hofmeister series, after the investigator who was the first to examine the effects of different salts on the physical properties of the proteins:

$HCl > HNO_3 >$ acetic acid $> H_2SO_4 >$ boric acid.

With the sodium salts of various acids the swelling decreases in the order:

Thiocyanates > iodides > bromides > nitrates > chlorates > chlorides > acetates > tartrates > citrates > sulphates.

Moreover, the order in the series may be affected by the concentrations of the substances used.

Such series are very difficult to understand, since the order of the compounds does not bear much relation to their ordinary chemical properties; for example, it is difficult to understand why acetic acid comes between nitric and sulphuric acids.

A way out of such difficulties has been found in recent years by the realisation that gelatin, like other proteins, behaves as an amphoteric substance and that its properties in solution depend on the hydrion concentration. For progress in this direction we are chiefly indebted to the work of Procter in England, Pauli in Austria, and Loeb in America, the basic ideas being due to Michaelis and Sörensen.

Gelatin is a stronger acid than base, so that hydrion, in the form of an external acid, has to be added to the solution in order to bring the gelatin to the isoelectric condition. At the isoelectric point the hydrion concentration, C_H, is approximately $2{\cdot}5 \times 10^{-5}$, that is, the pH ($= -\log C_H$) is 4·7, which is on the acid side of the neutral point of water (pH = 7·0). The theory of amphoteric electrolytes shows that at the isoelectric point their solutions should contain a maximum number of neutral particles and should therefore possess peculiar properties; in accordance with this it is found that the properties of swelling, viscosity, osmotic pressure, etc., show a minimum at that point.

On the acid side of the isoelectric point, *i.e.* at pH < 4·7, gelatin should behave as a base and form gelatin-acid salts, whilst on the alkaline side, pH > 4·7, it should act as an acid and form metal gelatinates. Loeb has endeavoured to show that this is true in several ways, of which the following may be quoted, where use is made of silver nitrate and gelatin which is brought to different pH's, all *less* than pH = 7·0, by treatment with varying concentrations of nitric acid. It can be predicted that on the alkaline side of the isoelectric point the gelatin, when treated with silver nitrate, will combine with the silver forming a silver gelatinate, and that the amount formed will be greater the higher the pH. If such a silver gelatinate is formed the silver should not be readily washed out by water and should remain in the gelatin after washing. On the acid side of the isoelectric point the gelatin should form gelatin nitrate, and it should be easy to remove the silver by washing. The following analytical figures show the agreement between theory and experiment.

c.c. 0·01N-Ag in combination with 0·25 gm. Gelatin at different pH's.

pH	3·6	3·7	3·9	4·1	4·3	4·6	4·7	5·0	5·3	5·7	6·1	6·4
c.c.	0·5	0·3	0·3	0·2	0·2	0·2	0·55	1·25	3·2	4·0	4·85	4·9

The retention of the silver by gelatin at a pH > 4·7 is well shown by the fact that if test tubes containing samples of the various gelatins are exposed to light, those which are on the alkaline side of the isoelectric point blacken, whereas those on the acid side do not, but remain transparent even when exposed to light for months.

Results similar to those with silver nitrate are obtained when a nickel or copper salt is used. With potassium ferrocyanide the gelatin should retain the ferrocyanide, as gelatin ferrocyanide, on the acid side of the isoelectric point, and this is found to be the case.

Results such as the above indicate the necessity of knowing the pH when any investigations are carried out, and also of making comparisons of any particular property at the same pH. When such comparisons are made, Loeb has shown that the Hofmeister series, with their anomalies, disappear; for example, the various monobasic acids, and acids such as phosphoric, oxalic, and citric acids, which dissociate into two ions at ordinary dilutions, have the same effect on swelling, viscosity, etc., at the same pH. Dibasic acids, such as sulphuric acid, which dissociate into three ions at ordinary dilutions, should, and do, give different effects from the monobasic acids. Similar results were found with alkalis, and abnormal effects produced by such salts as sodium acetate were shown to be due to the alteration of the pH of the gelatin solutions when the salt was added.

The increased swelling, viscosity, etc., which take place on either side of the isoelectric point and reach a maximum at pH's of about 3·5 and 8·5 respectively, are attributed by Pauli to the greater hydration of the gelatin ions formed, as compared with that of the neutral molecule, but Loeb is not in agreement with this. The latter postulates the existence in any protein solution of molecularly dispersed particles, floating side by side with submicroscopic particles occluding water, the amount of which is regulated by the Donnan equilibrium (Procter was the first to apply the Donnan equilibrium to the study of gelatin solutions). The osmotic effects are determined by the molecular particles, the viscosity effects by the submicroscopic particles. Any influence in the solution (change in H-ion concentration) by which the molecular dispersion is increased at the expense of the solid particles will result in an increase in the osmotic pressure and a decrease in viscosity, and the opposite conditions would result in the reverse of these effects.

The quantitative investigation of the physical properties of gelatin seems to have passed through three phases: in the first phase it was treated mainly as a colloid, in the second mainly as an amphoteric electrolyte, and now, in the third phase, as illustrated by Loeb's latest ideas, it is being realised that both its amphoteric and colloidal properties must be taken into account, since both play a part in its industrial applications. For example, its action as a protective colloid is of great importance in the preparation of photographic emulsions, but in the operations of developing and fixing its behaviour as an amphoteric substance must be considered, as may readily be realised when one remembers that the usual developers are alkaline, and that acid fixing baths are often used; the swelling of the gelatin film will vary in the baths, and in the change from the developer to the fixing bath the gelatin must, at some time, pass through the isoelectric point.

The structure of gels has been a bone of contention for a long time. Nägeli assumed that gels were two-phased and that the solid phase was crystalline, but Scherrer has not found any indication of crystalline structure in gelatin when examined by the X-ray method. Bütschli and van Bemmelen have advocated a cell-like structure, forming a net-work, and Hardy concluded that the solid phase consists of a solid solution of water in gelatin and the liquid phase a solution of gelatin in water; Wo. Ostwald has put forward the idea of a two-phase liquid-liquid system. Procter postulates the existence of a solid solution of the exterior liquid in the colloid in which both constituents are within the range of the molecular attractions of the mass, and Loeb has extended this idea. At the present time the conception of a fibrillar structure, as advocated by McBain and his co-workers for soaps, is gaining ground and is especially supported by Bogue in America and Moeller in Germany.

Current Topics and Events.

PROF. F. G. COKER was recently presented in London with the Howard N. Potts gold medal of the Franklin Institute of Philadelphia, awarded to him in recognition of his recent work on photo polarimetry. His method of determining stress in models of pieces and shapes made of homogeneous nitro-cellulose material was brought to the attention of the Institute's committee on science and the arts in February 1921, and it was found that the General Electric Company of Schenectady, New York, had in use Prof. Coker's apparatus. A committee was appointed to investigate the apparatus and method, and it reported that Prof. Coker's work was in the highest degree worthy of recognition by the Institute on account of the ingenuity and experimental skill shown "in applying the principles of photo elastimetry to the study of the magnitude and distribution of strains in models of pieces and shapes under stress." The medal, with the accompanying certificate and report upon which the award was made, was presented to Prof. Coker at a dinner at the Savoy Hotel by Dr. R. B. Owens, secretary of the Franklin Institute.

SOME very remarkable achievements in gliding, or soaring flight, are described by the Berlin correspondent of the *Times* in the issue of August 21. The flights were made by two of the competitors in a test competition on the Wasserkuppe, near Fulda, for the grand prize for motorless sail-planes offered by the German Aeronautical Industrialists Union. On August 18 one of the competitors, Herr Martens, remained in the air forty-three minutes, cruised over the starting-place, and then flew due west, at an altitude of about 320 feet, a distance of ten kilometres, landing comfortably in a meadow near Weyhers. On the following day Herr Hentzen remained in the air about one hour forty-five minutes at an altitude varying between three hundred and six hundred feet, then cruised to the starting-line and across country, landing also in Weyhers, near the spot where Herr Martens had landed the day before. His total time in the air was two hours and ten seconds. The wind was west-north-west, a moderate breeze with occasional gusts. It died away as he set off for the cross-country flight. The machine flown by Herr Martens was a monoplane, designed by the Science Section of the Hanover Technical High School, in conjunction with the Hanover Flying School. The *Times* correspondent gives the following details of its structure: span, 39·4 ft.; wind surface, 172·2 sq. ft.; surface pressure, 2·4 lb. to the sq. ft. The pilot sits directly under the plane. The controls are worked by both the hands and feet. Lilienthal's glider, the correspondent recalls, had a span of 23 ft. and a wind surface of 151 sq. ft.

WE learn from *Science* that from the list of applicants for the Bishop Museum fellowships Yale University has selected the following fellows for the year 1922–1923: Dr. H. W. Fowler, ichthyologist, Philadelphia Academy of Science; Dr. N. E. A. Hinds, instructor in geology, Harvard University; and Dr. Carl Skottsberg, director of the Botanical Garden, Göteborg, Sweden. Dr. Fowler will devote his attention to a study of the fish of Hawaiian waters; Dr. Hinds will continue his investigations of the geology of the island of Kauai; and Dr. Skottsberg proposes to make a study of the flora of Hawaii with particular reference to comparison with the plant life of Juan Fernandez and other islands of the south-east Pacific. The four Bishop Museum fellowships yielding one thousand dollars each were established in 1920 by a co-operative agreement between Yale University and the Bernice P. Bishop Museum of Honolulu. They are designed primarily for aid in research on problems in ethnology and natural history which involve field studies in the Pacific region.