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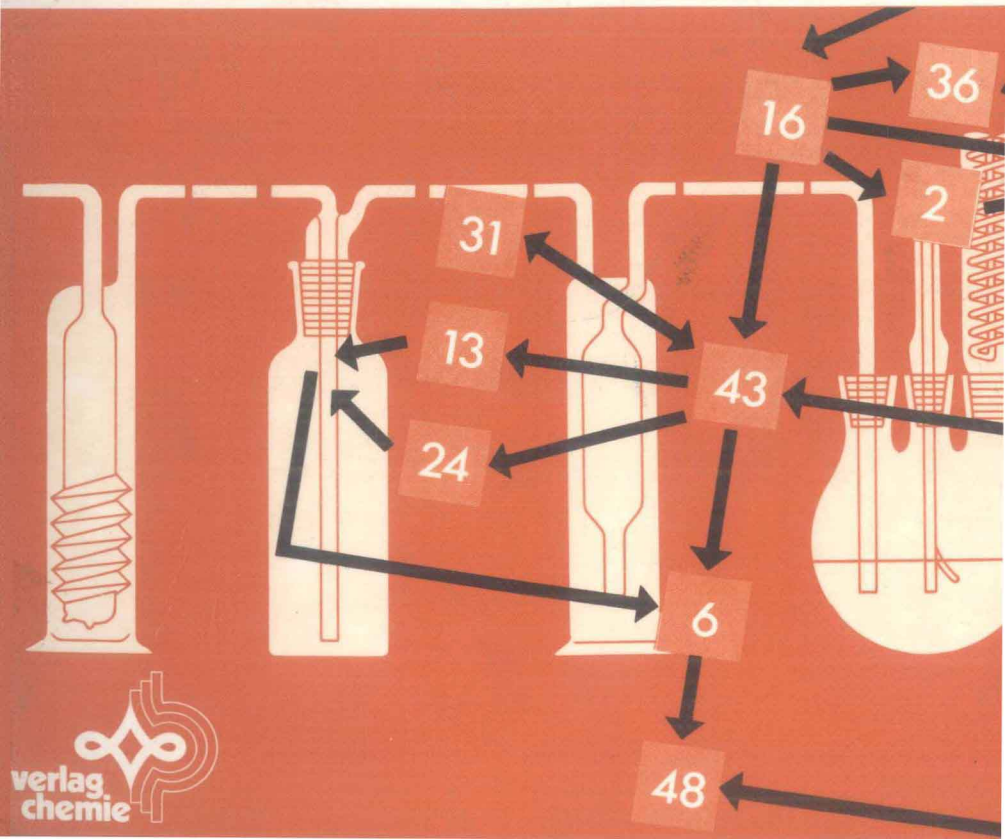
Chemistry Made Easy
Part II



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J. Nentwig/M. Kreuder/K. Morgenstern

Chemistry Made Easy Part II

A Programmed Course for Self-Instruction

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Weinheim · Deerfield Beach, Florida · Basel

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Preface

In 1969 we published in the German language an introductory chemistry text based on the method of programmed self-instruction. This method was developed mainly in the U.S.A. and began to make inroads into the German speaking world in the early 60s.

In order to make the technique of programmed learning and our subject matter optimally compatible we used a mixture of linear programming (after Skinner) and branched programming (after Crowder). More than 10 years later at the DIDACTA in Basle, an important European conference on education and educational methods, it was reported that mixed programs of this type had proved particularly effective. The term "hybrid program" was proposed for them.

For us, programming the material meant the creation of an enticing stimulus and an educational aid for the reader. A programmed text requires that the reader completes one step before the next can be made, and thus leads to intensive absorption of the material presented. The reader is drawn into a question-and-answer game in which he must find the solution to every question himself, thereby taking control of his learning performance. This places him in a classroom-like situation – with the added advantage that he determines the rate of progress himself. A well programmed text is, to a large extent, capable of replacing a tutor. Therefore, it is of particular value wherever the opportunity to attend classes or lectures does not exist (or was missed), and in cases where additional self-initiative is desirable.

The success of Part I of our programmed text surpassed all expectations. Following a second edition, which was reprinted several times, we brought out a completely revised third edition in 1971.

As we now know, the book is used by apprentices as well as by highschool, college, and university students. It serves as a self-instructional aid for students taking chemistry as a subsidiary subject and for employees in trade and industry.

Part II followed in 1971. Some of the topics covered in Part I were dealt with in greater depth here, and, in particular, organic chemistry was developed in some detail. This volume was also very well received, and appeared in 1975 as an extended and revised edition. The study of Part II does not presuppose mastery of Part I, although a knowledge of elementary inorganic chemistry and stoichiometry is required.

We ascribe the success of these books to the fact that all the programs were thoroughly tested in the classroom and in face-to-face tests before they were

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eventually published. They are thus not merely "desk programs" but instructional and learning aids which have proved their value in practice.

We are pleased that, following the continued success of the German edition, the publisher decided to undertake a translation of the work into English. The title of the English version, "Chemistry Made Easy", was chosen to reflect the ambition of our approach. The subtitle "A Programmed Course for Self-Instruction" denotes the didactic principle.

We hope that the English edition will prove as helpful and enlightening to those wishing to acquaint themselves with chemistry as did the German edition. Naturally, we would be grateful for any critical comments or suggestions.

The development and in particular the careful evaluation of programmed instructions require a large investment of time and money. We are most indebted to Bayer AG, Leverkusen, for their generous support of our work which originated in the vocational training courses we held some 15 years ago.

We wish to thank Dr. Dennis H. Rouvray and Dr. Edeline Wentrup-Byrne not only for their able translations (of Parts I and II, respectively), but also for several improvements and updating of the text.

Walsrode and Krefeld, in July 1982 J. N., M. K., K. M.

How to use this book

For those interested in acquiring a thorough grounding in the fundamentals of chemistry, this book provides an effective and simple means. The method of teaching utilized here is based on the proven approach of

programmed instruction.

The material we cover is presented in the form of 25 separate Programs. Although at the outset relatively light demands are made on the student, the situation changes as the student begins to advance through the book. Because our method is rather a specialized one, we outline below details of the techniques employed.

The material in each Program has been divided up into numerous small units or *frames*. At the end of every frame you, the student, are asked to answer one or more questions. The intention is to check whether you have really understood the content of the particular frame. Such questions may involve the setting up of a formula or an equation, the calculation of some quantity, the insertion of missing words into sentences and so on. After answering, you are advised to proceed to another frame where the correct answer is to be found or where any mistakes you may have made are analyzed. Only at this stage should you consider moving on to learn something new. By following this procedure you will be conducted step by step through all of the Programs.

To illustrate our approach more fully, we now present two very simple sample frames. These demonstrate the two basic ways in which questions will be posed. We mention in passing that you will continually have need of a pen (or pencil) and paper as you work your way through each Program.

---

1 Chemistry may be studied by an effective technique known as programmed instruction. The material covered in this volume is presented in the form of 25 separate Programs.

Now write out the completed version of the following sentence: We shall be studying chemistry here by means of ..... instruction.

Continue your reading at 11 .

You would then be required to write down: "We shall be studying chemistry here by means of *programmed* instruction."

Please do *not* write your answer within the actual frame itself. That would make it impossible for you to revise the material at some later stage! Be sure

to write all of your answers and notes on separate sheets of paper and not directly into the book.

After writing down your answer, turn to the next frame indicated; in the above case you would turn to frame number 11 . There you will be able to check your answer. (Do please make sure that in turning up the relevant frame you do not jump over into some other Program!)

The route to be followed through any given Program is indicated not by the page number but rather by the frame number located at the top left hand corner of each frame. Thus, you would check your answer here against the correct solution given in frame 11 . Filled-in words are always *italicized* in our solutions.

---

11 We shall be studying chemistry here by means of *programmed* instruction.

It has been demonstrated that programmed instruction is a more effective technique than learning from a conventional textbook.

A Program can facilitate learning by covering the material in small stages, by enabling the student to check each answer instantly and by permitting the student to work at his own individual pace throughout.

What is the most effective way of learning?

- By making use of a conventional textbook → 3
- By making use of a Program → 18
- There is no difference between the two ways → 34
- I cannot answer this question → 54

The student should now decide in favor of one of the four possible options and then turn to the frame indicated for the option chosen.

If the student had chosen frames 3 or 34 , he would discover that his answer was *not correct.* No one should feel too bad about that: additional help is always provided elsewhere as indicated. The correct answer is, of course, given in frame 18 .

Whenever you feel rather uncertain about how to answer a particular question and would appreciate having some further explanation on it, you are advised to choose a frame such as 54 . It is always wiser to follow this route than simply to guess at an answer.

During the coming weeks you will begin to realize that learning by means of programmed instruction is not only much easier and more enjoyable than conventional textbook learning, but also that you can progress through the material more rapidly. However, you should not look upon programmed instruction as a miracle method to attain your goal without any real work on your part being necessary! You will certainly *not* be able to learn chemistry "in your sleep" by this means. It is only by conscientiously working your way through each and every Program that success can be achieved.

Below we give some tips which should help to speed you on your way:

1. When commencing work on a Program you should be in a relaxed state and have sufficient time to complete the Program. It is best to work through a Program in *one* sitting if possible and then to re-work it again several times over the next few days. Of course, if you do have to interrupt working your way through a Program, simply jot down the number of the last frame you studied.

2. The individual frames are intended to be *worked* through and not merely *read* through. Do not leave a frame until you are quite certain you have grasped its content. A Program is not designed in such a way that you can work backwards through it again! Check all your answers very carefully against those given in the next frame and correct any errors you may have made. Do not get upset if you make mistakes the first time you work through a Program. However, it would be a great pity if you did not learn from the mistakes you make!

3. Absolute *honesty* is called for at those points where you are asked to select one out of several possible answers to a question. We recognize, of course, that it would be only too easy to cheat here. Our advice, however, is always to make a serious attempt to arrive at the correct answer. Cheating will certainly *not bring* the kind of *success* you could otherwise expect. From time to time you will have the opportunity of choosing as your answer some such phrase as "I do not understand the question" or, simply, "I do not know". Never hesitate to select this answer if you genuinely feel uncertain. You will then be guided to a frame where additional help is available.

4. The continual checking of your progress and the choices you have to make in answering questions serve to introduce a certain excitement into the learning process. The learning process is thereby transformed into something resembling the playing of a game. This effect is an intended one and is highly desirable, even though there is a potential danger that students may thereby be encouraged to work through Programs too fast and perhaps even start guessing at answers. Be on your guard against this possible disadvantage! You should always endeavor to work slowly, to remain calm and to maximize your concentration.

Success in learning requires *active participation* on the part of the student, *immediate checking* of all answers and progression through the material at an *individually paced speed.* Programmed instruction satisfies all of these requirements.

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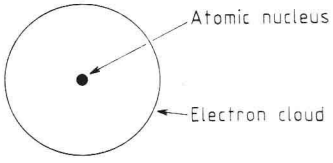
Contents

Program 1

The Structure of the Atom

1 This second part of "Chemistry made easy – a Programmed Course for Self-Instruction" will commence with a somewhat more detailed account of the structure of the atom, since without it a good understanding of the chemical properties of molecules is impossible.

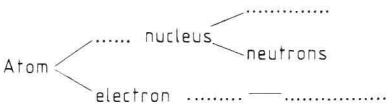
Every atom consists of a nucleus and an outer electron cloud.



The nucleus consists of protons and neutrons.

As the name suggests, electrons make up the electron cloud.

Complete the following scheme and check your answer at 11 .



2 An atom possessing 4 protons and 5 neutrons has the *atomic number* 4.

The number of neutrons does not affect the magnitude of the atomic number.

How many electrons are there in the electron cloud of an atom with the atomic number 7?

Check your answer at 12 .

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